RESEARCH BULLETIN NO. 19

THE UNIVERSITY OF NEBRASKA

BULLETIN

OF THE

AGRICULTURAL EXPERIMENT STATION

OF

NEBRASKA

THE REGIONAL ADAPTATION OF CORN IN NEBRASKA

By T. A. Kiesselbach and F. D. Keim

Distributed April 1, 1921

LINCOLN, NEBRASKA
U. S. A.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA.

THE GOVERNING BOARD

(THE REGENTS OF THE UNIVERSITY)

HON. PHILIP L. HALL, *President,* Lincoln.......Term expires January, 1923
HON. HARRY D. LANDIS, *Vice President,* Seward..Term expires January, 1923
HON. FRANK W. JUDSON, Omaha...............Term expires January, 1925
HON. JOHN R. WEBSTER, Omaha................Term expires January, 1925
HON. WILLIAM L. BATES, Lodgepole...........Term expires January, 1927
HON. GEORGE L. SEYMOUR, Elgin...............Term expires January, 1927

SAMUEL AVERY, PH. D., LL. D., *Chancellor*
J. S. DALES, M. PH., *Financial Secretary*

THE STATION OFFICERS

E. A. BURNETT, D. SC., *Director*
W. W. BURR, B. SC., *Assistant Director*
W. H. BROKAW, *Director of Extension Service*
C. A. LEWIS, B. SC., *Bulletin Editor*

THE WORKING STAFF

ARTHUR ANDERSON, B. SC., *Assistant in Agronomy*
E. M. BROUSE, B. SC., *Superintendent Experimental Substation,* Valentine
LAWRENCE BRUNER, B. SC., *Entomology*
W. W. BURR, B. SC., *Agronomy (Chairman)*
*J. W. CALVIN, B. SC., *Associate in Agricultural Chemistry*
R. W. DAWSON, B. SC., *Assistant in Entomology*
ELI DUNCOMBE, B. SC., *Analyst*
H. C. FILLEY, A. M., *Rural Economics (Chairman)*
*J. H. FRANDSEN, M. S. A., *Dairy Husbandry (Chairman)*
R. W. GOSS, M. S., *Assistant in Plant Pathology and Physiology*
H. J. GRAMLICH, B. SC., *Animal Husbandry (Chairman)*
J. W. HENDRICKSON, A. M., *Assistant in Dairy Husbandry*
J. A. HOLDEN, B. SC., *Superintendent Experimental Substation,* Mitchell
R. F. HOWARD, A. M., *Horticulture (Chairman)*
F. D. KEIM, M. S., *Assistant in Agronomy*
T. A. KIESSELBACH, PH. D., *Agronomy*
W. J. LOEFFEL, B. SC., *Assistant in Animal Husbandry*
G. A. LOVELAND, A. M., LL. B., *Meteorology*
JOHN LUITHLY, B. SC., *Assistant in Dairy Husbandry*
W. E. LYNESS, B. SC. IN AGR., *Assistant in Agronomy*
H. M. MARTIN, V. M. D., *Assistant in Animal Pathology and Hygiene*
F. E. MUSSEHL, B. SC., *Poultry Husbandry*
F. R. NOHAVEC, B. SC. IN A. E., *Assistant in Agricultural Engineering*
G. L. PELTIER, PH. D., *Plant Pathology*
J. O. RANKIN, A. M., *Assistant in Rural Economics*
J. C. RUSSELL, M. S., *Assistant in Agronomy*
O. W. SJOGREN, B. SC. IN A. E., *Agricultural Engineering (Chairman)*
L. V. SKIDMORE, D. V. S., *Assistant in Animal Pathology and Hygiene*
W. P. SNYDER, M. S., *Superintendent Experimental Substation,* North Platte
M. H. SWENK, M. S., *Entomology (Chairman)*
F. W. UPSON, PH. D., *Chemistry (Chairman)*
L. VAN ES, M. D., V. S., *Animal Pathology and Hygiene (Chairman)*
H. O. WERNER, B. SC., *Assistant in Horticulture*
C. C. WIGGANS, PH. D., *Assistant in Horticulture*
**L. L. ZOOK, B. SC., *Agronomist,* North Platte

*Resigned.
**Detailed from Office of Dry Land Agriculture, United States Department of Agriculture, Washington, D. C.

CONTENTS

SUMMARY

Adaptation in corn is looked upon as the fortuitous or chance modification or acquisition of hereditary characters or qualities thru the favorable reaction of the crop to its environment. This may occur thru, (1) mutation from an individual, thus producing a new character; (2) Mendelian recombination of unit characters resulting in new forms; and (3) segregation of the more suitable types present in a mixed population. Survival of the fittest is the active selective principle.

Nebraska's climate is very diversified and affords a splendid opportunity for studying the regional adaptation of corn. Soil differences are not nearly so great a factor in this adaptation as is climate.

As extremes in climatic conditions, western Nebraska compared with eastern Nebraska normally has a six-degree F. lower temperature during the corn growing season. The frost-free period is fifty days shorter, and the precipitation one-half as great. The growing season of northern Nebraska is four degrees F. cooler than of southern Nebraska, and the frost-free period is about twenty days shorter. The precipitation from north to south is rather similar. Much of the country south of the Platte River is subject to occasional hot winds which are far less common north of this river. No statistics are to be had regarding the evaporation rates for various parts of the State, but experience indicates that the evaporation rate decreases from south to north. This increases the effectiveness of the rainfall.

With an approach from the relatively favorable conditions of eastern Nebraska to the combined short season, low temperature, and low precipitation of western Nebraska, the native corn types assume a more and more dwarfish growth habit. The stalks become shorter and bear the ear closer to the ground. The total leaf area per plant decreases thru a reduction in number, length, and width of the leaves. The ratio of leaf area to dry plant substance and the proportion of grain to stover remain fairly constant. The ears become shorter, smaller in circumference, fewer rowed and frequently are scrubby in appearance. The shelling percentage lowers, and the kernels become shorter and more flinty, as well as slightly lighter in weight.

The leaves, being the seat of transpiration and food synthesis, might be expected to reflect structural adaptation to adverse conditions, if such adaptation occurs. Therefore, extensive studies of leaf structure have been made. The leaf and epidermal thicknesses of native types are fairly constant thruout the State. There is a tendency in the less favored regions for the stomata to be somewhat smaller and greater in number per unit leaf

area. This stomatal character is associated with a rather corresponding reduction in size of epidermal cell, all of which may be ascribed to a more dwarfish development. The number of vascular bundles per unit cross-section of leaf is fairly constant.

While some of the vegetative characters, such as total leaf area and plant weight, may reduce as much as 300 per cent, no important histological leaf characters exhibit more than 15 per cent deviation in the case of native types growing in the most adverse as compared with the most favored parts of the State.

Practically speaking, adaptation with corn consists in a morphological rather than in a histological reaction.

As a concrete example of the foregoing adaptive reactions, the 1915 difference between home-grown native Richardson County and Kimball County corn types may be cited. These two localities represent the extremes of corn growing conditions within the State. Comparing the measurements of Richardson County corn with those of Kimball County corn, we have the following ratios: Stalk height, 100:60; ear height, 100:35; leaf area, 100:36; stover weight, 100:49; ear weight, 100:24; grain weight, 100:20; total plant substance, 100:34; shelling percentage, 100:84; leaf area, per unit dry matter, 100:100; ear length, 100:65; ear circumference, 100:81; kernel length, 100:73; leaf thickness, 100:96; thickness of upper epidermis, 100:97; thickness of lower epidermis, 100:97; number of vascular bundles per unit of cross-section of leaf, 100:104; number of stomata per square millimeter of upper epidermis, 100:113, and of lower epidermis, 100:115; length of stoma of upper epidermis, 100:89, and of lower epidermis, 100:90; length of epidermal cell of upper epidermis, 100:92, and of lower epidermis, 100:97; and width of epidermal cell of upper epidermis, 100:99, and of lower epidermis, 100:92.

The immediate effect of moving corn from its native environment to less favorable conditions, climate being the chief variable factor, is generally a reduction in both vegetative growth and grain production. The stunting growth effect extends to the cell unit, which in turn is accompanied by histological changes that can not apparently be regarded as of an adaptive nature. These changes may be illustrated by comparison of native Lancaster County corn when grown at home and when grown in the more adverse region of Kimball County. Using the Lancaster County crop as a basis, the relative results were as follows: Plant height, 100 and 80; ear height, 100 and 52; leaf area, 100 and 78; stover weight, 100 and 62; ear weight, 100 and 1; grain weight, 100 and 0.8; total dry matter,

100 and 26; shelling per cent, 100 and 63; leaf area per gram of dry matter, 100 and 300; ear length, 100 and 40; ear circumference, 100 and 44; leaf thickness, 100 and 100; average epidermal thickness, 100 and 97; cuticular thickness, 100 and 103; number of vascular bundles per unit of cross section of leaf, 100 and 116; average number of stomata per unit leaf area, 100 and 107; average length of stomata, 100 and 97; average length of stomatal aperture, 100 and 90; average length of epidermal cell, 100 and 95; average width of epidermal cell, 100 and 95. Altho the slightly reduced length of the stomatal aperture taken by itself might be interpreted as an adaptive reaction to retard transpiration, yet this is contradicted by an increase in the relative number of stomata.

On the other hand, moving corn to more favorable conditions than its native habitat accelerated the vegetative growth and grain production. This stimulating growth effect extended to the cell unit with its accompanying histological changes which again can not be regarded as adaptive in nature. As a parallel illustration with the preceding case, native Kimball County corn grown at home may be compared with the same corn planted in the more favorable region of Lancaster County. The changes occurring as a result of this transfer practically reversed those of the preceding case in which corn was moved to less favorable conditions. Thus, basing results on the Kimball County crop as 100 per cent, the following relative values are had: Plant height, 100 and 129; ear height, 100 and 154; leaf area, 100 and 140; stover weight, 100 and 161; ear weight, 100 and 135; grain weight, 100 and 131; total dry matter, 100 and 146; shelling per cent, 100 and 97; leaf area per gram of dry matter, 100 and 96; ear length, 100 and 113; ear circumference, 100 and 107; leaf thickness, 100 and 109; average epidermal thickness, 100 and 106; average cuticular thickness, 100 and 91; number of vascular bundles per unit cross section of leaf, 100 and 96; average number of stomata per unit leaf area, 100 and 90; average length of stomata, 100 and 111; average length of stomatal aperture, 100 and 122; average length of epidermal cell, 100 and 105; average width of epidermal cell, 100 and 108.

The actual hereditary difference between types adapted to favorable and to unfavorable climatic conditions may perhaps be best determined by comparing both in the same environment under favorable conditions. Eastern and western Nebraska corn may be thus compared by growing at the Nebraska Experiment Station in Lancaster County. Under these conditions western Nebraska corn was much smaller in plant size, leaf area, and dry matter. Plants from seed of both sources were rather similar as to leaf thickness, epidermal and cuticular thickness, relative

numbers of vascular bundles, number of stomata per unit leaf area, and size of stomata. A slightly shorter stomatal aperture accompanied by a slightly smaller epidermal cell appears to be characteristic of the short season dry land types of western Nebraska. Such a shortening of stomatal aperture is not, however, effective in checking the transpiration rate per unit leaf area.

During four years Kimball County and Lancaster County corn were compared by the potometer method as to their relative transpiration rates. The Lancaster County plants which were 51 per cent taller, had 88 per cent greater leaf area and 79 per cent greater dry matter than the Kimball County corn, used 81 per cent more water per plant, 3 per cent less water per unit leaf area, and equal amounts of water per unit dry plant substance produced. In a comparison of two varieties each from western and eastern Nebraska and from New York state, the seasonal transpiration per unit leaf area was respectively, 102, 101, and 100 grams. The corresponding total plant transpiration for seed from the above three sources was respectively, 85.778, 114.653, and 97.218 kilograms. The data indicate that adaptation of corn to a region of moisture shortage consists in the reduction of vegetative development and consequent reduction in the amount of water used by the individual plant.

In a comparative two-year yield test at the Experiment Station of corn types representing twelve distinct regional areas within the State, those from nearest home yielded the most. When these types are grouped into eastern, central, and western Nebraska groups, the yields were respectively, 59.8, 46.2, and 31.6 bushels per acre. These yields are for equal planting rates normal for adapted types in Lancaster County. The corresponding maturity dates were: September 24, September 21, and September 12.

In a three year comparison at the Nebraska Experiment Station of: (1) Native Experiment Station Hogue's Yellow Dent corn, (2) seed from nine local farmers, and (3) seed from seven distant eastern Nebraska farmers, the relative grain yields of the three groups were respectively, 100, 94, and 91. Of corn brought to the Station from a distance, that from three southeastern counties yielded 56.9 bushels as compared with an average yield of 63.7 bushels for seed from four northeastern counties and 66.7 bushels for the home grown Hogue's Yellow Dent. The relative yields of these three groups were 85, 96, 100.

In a two-year test comparing native Nebraska Experiment Station corn with native seed from the Experiment Stations of eight neighboring states, the local seed yielded an average of ten bushels or 18 per cent more than the imported seed. Seed from several states yielded quite as well as home-grown seed. It

may be concluded from both of the above tests that native seed is in general superior to imported seed. However, it is entirely possible to secure seed, (1) from neighboring farmers, (2) from a distance within one's own state, and (3) from other states, which may be substituted for the native home grown seed without detriment. Nevertheless, the importation of seed corn from a distance is hazardous.

Lines of greatest type similarity run diagonally across the State in a northeasterly and a southwesterly direction. Along such lines the more favorable temperature and longer growing season of the south tends to counterbalance the more favorable precipitation of the north in their effects upon the hereditary growth habits of corn. When seed corn is moved far within the State, it is usually safest to move along such lines.

Corn native to dry-land regions is often credited with especially high efficiency in grain production. In contrast with corn native to more humid regions, it is said to produce a relatively large amount of grain in proportion to its vegetative growth. The data in these investigations fail to substantiate such a relationship. To some extent at least, this apparently erroneous conception is due to faulty methods of comparison. To illustrate, small early types are frequently moved to more favorable conditions and compared there with larger types at planting rates normal for the larger corn. Such a planting rate provides relatively more optimum conditions for the individual plants of the smaller types which frequently results in a higher proportion of grain production.

As an average for 1915 and 1916, the ratio of grain to stover (stalk and leaves) for eastern, central, and western Nebraska types grown in their home environment were respectively, .98, .84, and .68. In 1916, when eastern, central, and western Nebraska types were grown under the favorable conditions of Lancaster County, the respective ratios were, 1.04, .84, and .84. When the same three groups of corn were grown in Thurston County with conditions slightly more unfavorable for the large eastern Nebraska types and yet highly favorable for the early western types, respective ratios were, .65, .82, and 1.02. When grown in extreme western Nebraska (Kimball County), these ratios were respectively .11, .52, and .79. In these last two comparisons the western types are at a great advantage because of fuller maturity, but the increased proportion of grain to stover is due to the environmental adaptation and not to any principle of greater inherent efficiency of the western plant.

The practical conclusions deducted from the data in this bulletin are borne out by observations and experiences in the practical farm operations thruout the State.

THE REGIONAL ADAPTATION OF CORN IN NEBRASKA

T. A. KIESSELBACH AND F. D. KEIM

OBJECT AND SCOPE OF THE INVESTIGATION

The purpose of this investigation was to determine some of the factors involved in the regional adaptation of corn. The procedure has been to make a comparative study of native corn types, known to be locally adapted to various regional areas in Nebraska thru long growth there. The work has been confined to the single species group—Zea mays indentata. No one variety of a common source is grown thruout the state, and therefore it has been impossible to keep within a single variety. It would appear that the data should indicate morphological and histological plant characteristics involved in the adaptation of dent corn to various environments, as found in Nebraska. Comparative yield tests of corn from various sources are also reported.

The growing of adapted corn is of great importance to the farmer. The simple matter of planting well adapted, rather than poorly adapted seed may determine whether he meets with success or failure in his corn growing. Corn has now been grown in all agricultural areas of the State for many years, and experience indicates that in the main fairly well adapted types are being grown. An attempt is made to analyze what constitutes such adaptation.

Altho objection has been raised by several investigators* to the use of the term "adaptation," it is used in this paper because of its popular usage, and for the reason of being most expressive of the collective phenomenon of the favorable hereditary reactions of plants to their environment. Plants should not be credited with teleologic or purposive variation. Crop adaptation results from fortuitous or chance variation, and survival of the fittest, thus coming into a greater harmony with the environment. The selective force may be either natural, or artificially directed. Hereditary character changes are involved.

*Omission of a historical review from this bulletin has been necessitated thru a lack of space.

A distinction must be made between these adaptive changes and mere temporary growth response. Hereditary character changes in corn may occur by: (1) Mutation from an individual, thus producing a new character; (2) Mendelian recombi-

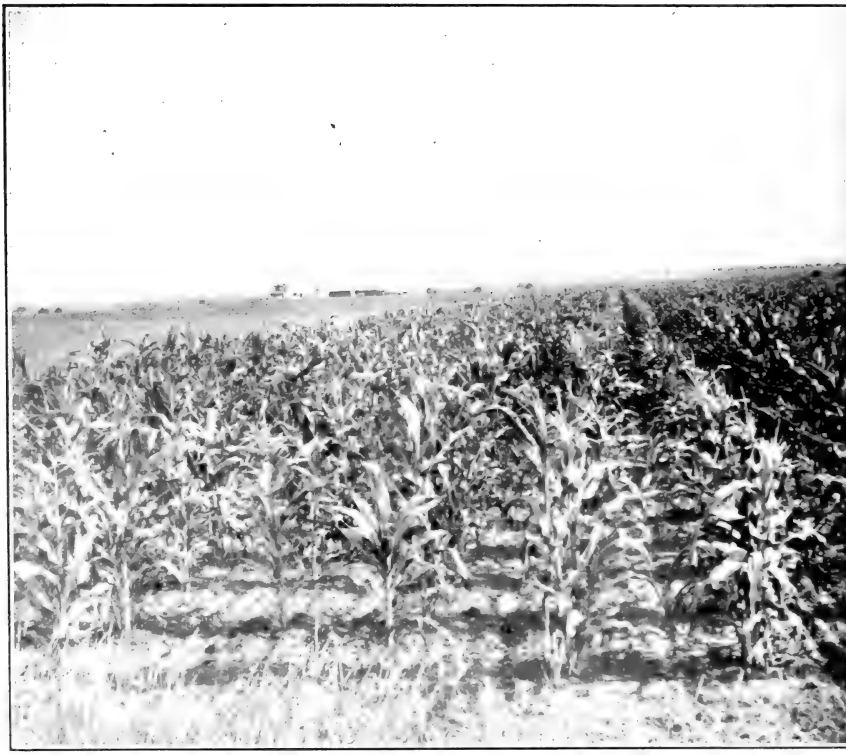

Fig. 1—A typical field of corn in western Nebraska.

nation of unit characters resulting in new forms; and (3) segregation of the more suitable types present in a mixed population.

Since the crop environment of any locality is necessarily somewhat fluctuating or variable from year to year, important crop adaptation characteristics are congenial for the most part to the mean or normal conditions. A crop can not be in full accord every year with a fluctuating environment. Consequently, a crop to be well adapted from an agricultural standpoint must be capable of some adjustment to variable conditions.

Adaptation occurs as a favorable reaction to some one or more growth factors of the environment. The environmental conditions which are apt to become limiting factors in Ne-

braska's corn crop are heat, moisture, and soil fertility. Nebraska's great regional diversity of crop growing conditions affords a splendid opportunity for this study. The environmental and corn types surveys follow.

Fig. 2—A typical field of corn in eastern Nebraska.

THE ENVIRONMENTAL SURVEY OF NEBRASKA'S CORN GROWING CONDITIONS

Climate and soil are the chief variable growth factors in the State, where corn is grown, and variations within these appear to be almost wholly responsible for the widely differing corn types found in various parts of the State.

Climatic differences may be readily analyzed, and their collective effects on corn are very apparent. The effects of regional soil differences are far less pronounced. In general, thruout the State where corn is grown, the land is fertile and capable of producing large crops. Greater local than regional differences

in soil fertility are found with the exception perhaps of the great Sand Hills Area of north and west central Nebraska, as compared with the balance of the State. Special adaptations to these soil differences are rather obscure. Some communities have certain favorite corns for the very fertile bottom land and others for the poorer hills and uplands. The writers have not undertaken in these investigations to substantiate these local preferences.

These investigations are especially concerned with the crop growing conditions in twelve counties in different parts of the State, namely: Richardson, Lancaster, Washington, Thurston, Holt, Nuckolls, Kearney, Lincoln, Cherry, Grant, Kimball and Dawes. It is for corn grown in these counties that the comparative type studies were made.

CLIMATE

The climatic considerations of primary importance in a study of the environment as related to the regional adaptation of corn are: (1) Temperature, (2) precipitation, and (3) atmospheric power for evaporation. The accompanying climatic data are based largely upon observations made by the United States Weather Bureau.* The normal climate of any region is best represented by the average for a large number of years. Thirty or more years have been averaged in the following data.

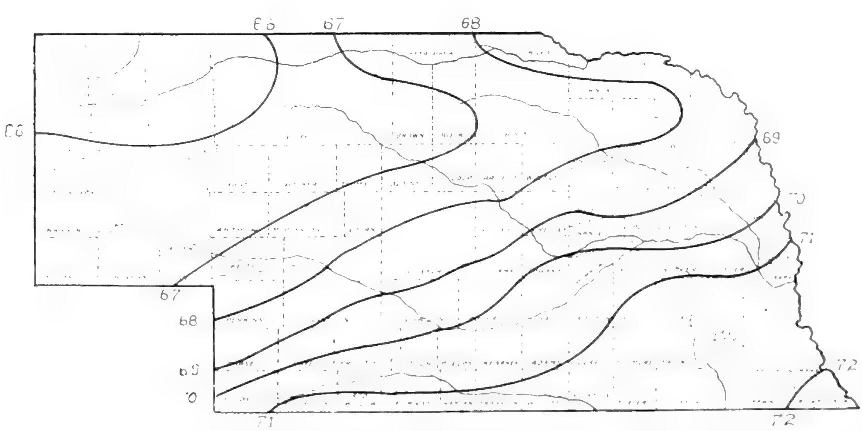

Fig. 3—Normal isotherms for the corn growing season of May, June, July, and August. (Degrees F.)

*The writers are indebted to Director G. A. Loveland of the Nebraska Section of the Weather Bureau for access to the records and for help in compilation.

The seasonal rainfall and temperature for the years 1915 and 1916 are also given for the twelve localities in the State where corn types were studied in detail during those years.

REGIONAL TEMPERATURE VARIATIONS WITHIN THE STATE

Important aspects of temperature related to these studies are: (1) mean temperature of the corn growing season, (2) duration of the frost-free growing season, and (3) occurrence of excessive temperatures of short duration, especially when accompanied by abnormally high wind velocity.

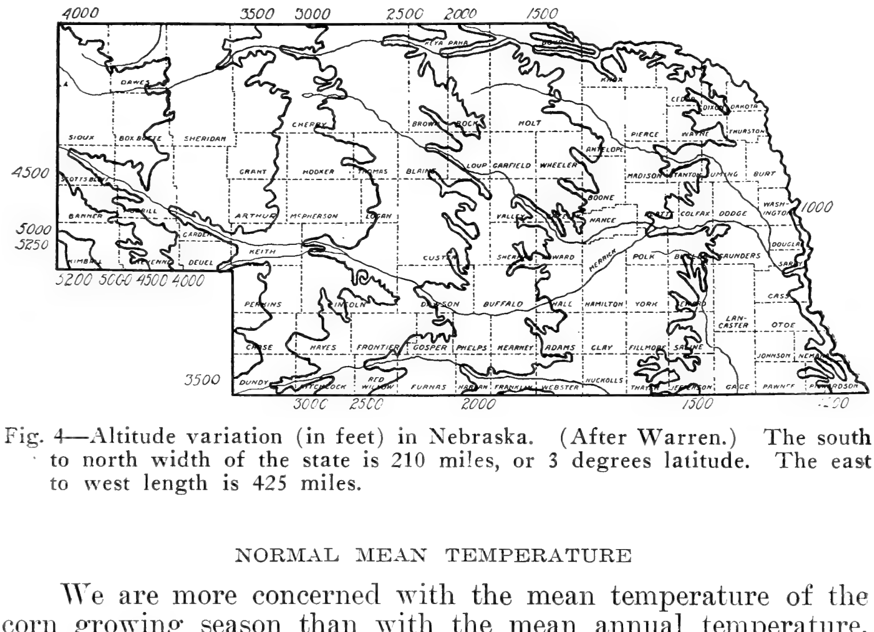

Fig. 4—Altitude variation (in feet) in Nebraska. (After Warren.) The south to north width of the state is 210 miles, or 3 degrees latitude. The east to west length is 425 miles.

NORMAL MEAN TEMPERATURE

We are more concerned with the mean temperature of the corn growing season than with the mean annual temperature. Accordingly, variations thruout the State in the normal mean temperature for the period of May to August, inclusive, have been compiled and are charted in Figure 3. In response chiefly to differences in latitude, this mean seasonal temperature is found to decrease approximately four degrees from the southern to the northern border of the State. Due to the combined effects of increased latitude and altitude, (Figure 4), the corresponding mean temperature of extreme western Nebraska is seven degrees lower than for extreme southeastern Nebraska. The altitude rises rather continually from 1,000 feet in the southeast to a maximum of about 5,300 feet in the west. In general, the isotherms run from the northeast to the southwest.

NORMAL LENGTH OF FROST-FREE GROWING SEASON

The length of the frost-free period between the last killing frost in the spring and the first killing frost in autumn, (Figures 5 and 6), is expressive of the relative length of the growing season available to corn in various parts of the State. The mean duration of the frost-free period in the extreme southeast is approximately 171 days, as compared to 121 days in the northwest. The lines of equal frost dates tend to run in a northeasterly direction.

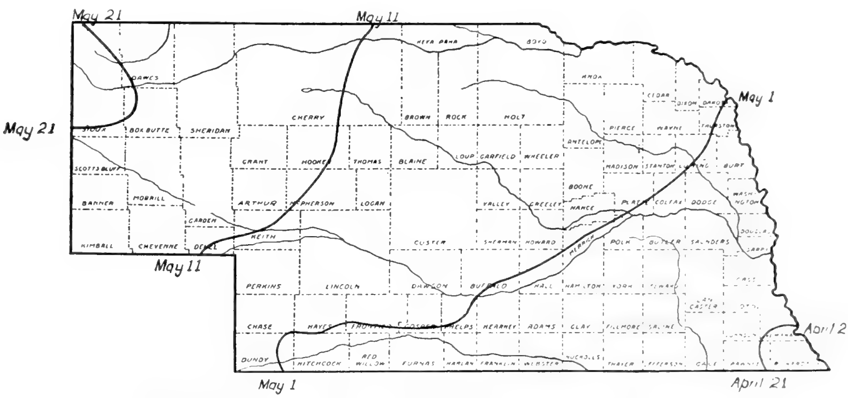

Fig. 5—Average dates of last killing frost in spring.

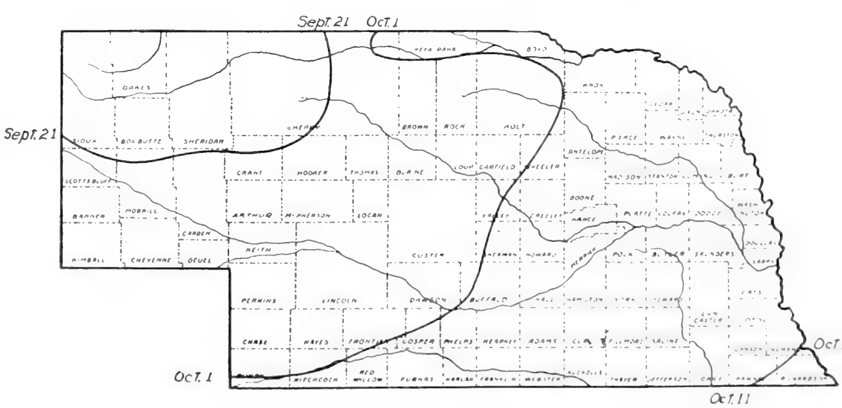

Fig. 6—Average dates of first killing frost in autumn.

REGIONAL MOISTURE VARIATIONS WITHIN THE STATE

The principal moisture considerations comprise: (1) total annual precipitation together with its character and distribution thruout the year: (2) evaporating power of the atmosphere

as a summary expression of temperature, relative humidity, and wind velocity; and (3) absorptive and retentive character of the soil for moisture.

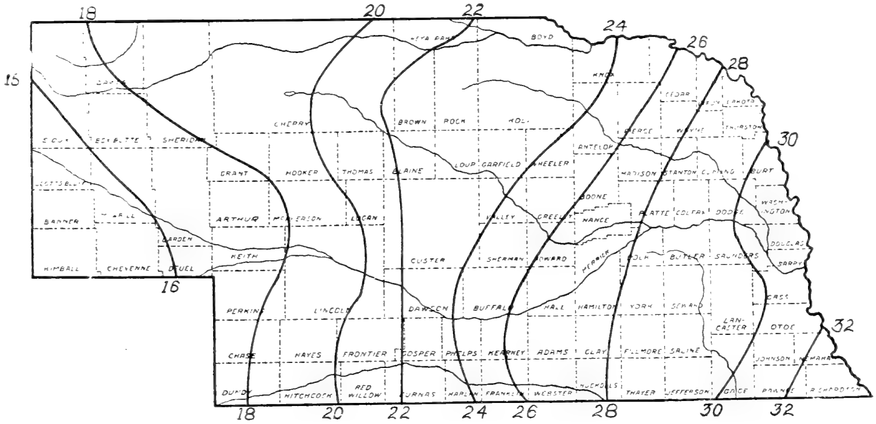

Fig. 7—Average annual precipitation for the different sections of Nebraska. (Inches.)

MEAN ANNUAL PRECIPITATION

As shown in Figure 7, the annual precipitation falls rather gradually from 32 inches in the extreme southeast to 16 inches in the extreme western part of the State. In the eastern two-thirds of the State the lines of equal rainfall run in a somewhat northeasterly direction. The character and distribution of the rainfall is rather uniform thruout the State, being of the torrential type and coming largely during the crop growing season. (Table 1.)

TABLE 1.—*Normal Monthly Distribution of Rainfall in Nebraska. Average of Entire State for Thirty Years.*

Month	Inches	Month	Inches
January	.68	July	3.51
February	.71	August	2.62
March	1.16	September	1.84
April	2.40	October	1.49
May	3.60	November	.68
June	3.93	December	.69

Average annual rainfall, 23.31 inches.

EVAPORATION RATE

The power of the atmosphere to evaporate water has a marked influence upon the effectiveness of the rainfall. Data

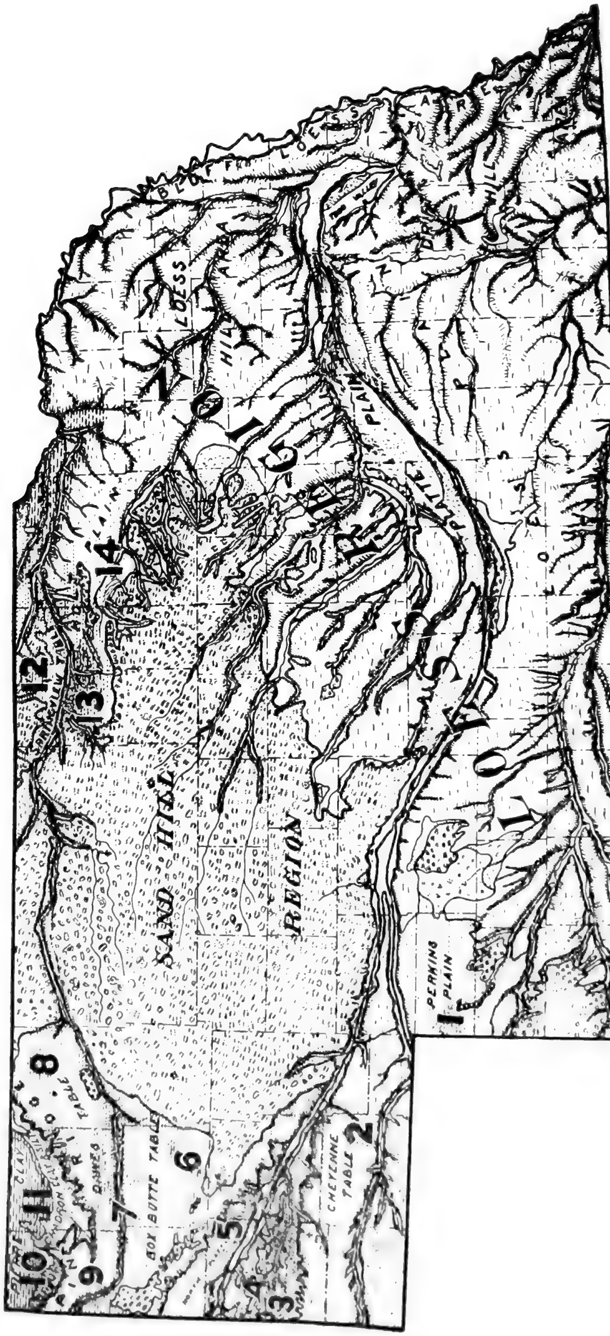

Fig. 8.—Map showing the Soil Regions of Nebraska. (By Condra, director Nebraska Soil Survey.) Numbers 1 to 14 represent the divisions of the High Plains Region. The divisions are 1, Perkins Plain; 2, Cheyenne Table; 3, Pumpkin Creek Valley; 4, Wildcat Ridge; 5, North Platte Valley; 6, Box Butte Table; 7, Niobrara Valley; 8, Dawes Table; 9, Pine Ridge; 10, Hat Creek Basin; 11, White River Basin; 12, Springview Table; 13, Ainsworth Table; 14, Holt Plain.

TABLE 2.—*Summary of Normal Climatic Conditions, Altitude, and Soil Type at Various Points in the State Where Corn Types Were Studied.*†

County	Mean temperature of corn growing season*	Last spring frost	First fall frost	Length of frost free period	Annual precipitation	Altitude	Kind of soil
	Degrees F.	*Date*	*Date*	*Days*	*Inches*	*Feet*	
Richardson	73–72	4–21	10–11	173	32	900	Glacial silt loam
Washington	71–70	4–26	10–5	162	31	1,000	Loess
Thurston	69–68	5–1	10–1	153	29	1,100	Loess
Lancaster	71–72	4–25	10–9	167	29	1,200	Loess terrace
Nuckolls	71–72	4–27	10–5	161	28	1,700	Loess
Kearney	70–69	4–29	10–2	156	26	2,200	Loess
Holt	68–67	5–7	9–28	144	23	1,700	Fine sandy loam
Lincoln	69–68	5–8	9–25	140	20	3,100	Sandy loess
Cherry	67–66	5–11	9–23	135	20	3,000	Fine sandy loam
Grant	67–66	5–13	9–21	131	18	3,500	Sandy loam
Dawes	66–65	5–17	9–19	125	18	3,800	Fine sandy loam
Kimball	66–65	5–14	9–23	132	16	4,800	Fine sandy loam

†Data constructed from Figures 3 to 8.
*May, June, July, August.

are not available to show the relative differences in evaporation rate for different parts of the State. It is quite likely, however, that as we progress in a northwesterly direction, the accelerating evaporation effects of a lower humidity are in part offset by the reduced temperature. The evaporation rate is unquestionably reduced from the south to the north. Most of the country south of the Platte River is subject to occasional detrimental hot winds with excessive evaporation power, while such winds are seldom known farther north.

ABSORPTIVE AND RETENTIVE POWER OF THE SOIL

Regionally, the soil differs somewhat in absorptive and retentive power due primarily to a difference in texture. The soils of central and western Nebraska are somewhat more porous than eastern soils, and consequently less subject to runoff. In

TABLE 3.—*Precipitation During Five Spring and Summer Months in Regions Where Corn Adaptation Studies Were Located. 1915.*

Location	Precipitation					
	April	May	June	July	August	Total
County (1)	*Inches* (2)	*Inches* (3)	*Inches* (4)	*Inches* (5)	*Inches* (6)	*Inches* (7)
EASTERN NEBRASKA						
Richardson	1.87	7.62	5.69	9.93	5.28	30.39
Washington	1.25	7.72	4.45	8.55	2.92	24.89
Thurston	.60	5.92	7.74	6.95	2.45	23.66
Lancaster	1.37	4.77	4.03	6.74	5.57	22.48
Nuckolls	1.92	5.17	9.71	4.94	3.29	25.03
Average	1.40	6.24	6.32	7.43	3.90	25.29
CENTRAL NEBRASKA						
Kearney	3.06	6.04	8.44	7.96	6.84	32.34
Holt	2.63	4.85	5.17	5.30	1.31	19.26
Lincoln	7.10	5.55	3.39	4.66	4.23	24.93
Cherry	3.46	3.84	4.52	7.40	.89	20.11
Average	4.06	5.07	5.38	6.33	3.32	24.16
WESTERN NEBRASKA						
Grant*	6.31	4.62	6.81	4.27	5.65	27.66
Dawes	2.93	3.16	4.84	2.99	5.11	19.03
Kimball	5.03	3.05	3.53	1.07	1.75	14.43
Average	4.75	3.61	5.06	2.74	4.17	20.37

*Rainfall in Grant County was not available for 1915, and data from Arthur County, bordering on the south, have been supplied.

the Sand Hills Area of north and west central Nebraska there is probably justification for the belief that the type of soil found there is more resistant to atmospheric evaporation of soil moisture than are the heavier soils elsewhere.

SOIL FERTILITY

Regionally, with the exception of much of the Sand Hills Area and north and west central Nebraska, the soils of this State that are not subject to serious erosion are fertile, and the regional adaptation of corn is probably not greatly influenced by difference in soil fertility. The accompanying soil map by Condra indicates the general soil areas found.

TABLE 4. — *Precipitation During Five Spring and Summer Months in Regions Where Corn Adaptation Studies Were Located. 1916.*

Location	Precipitation					
	April	May	June	July	August	Total
County (1)	*Inches* (2)	*Inches* (3)	*Inches* (4)	*Inches* (5)	*Inches* (6)	*Inches* (7)
EASTERN NEBRASKA						
Richardson	3.09	8.24	2.64	2.73	6.72	23.42
Cass	2.21	4.60	4.33	.73	7.01	18.88
Thurston	.73	5.16	3.07	.83	3.71	13.50
Lancaster	2.69	3.48	3.11	1.29	6.70	17.27
Nuckolls	2.08	4.30	3.45	.35	1.67	11.85
Average	2.16	5.16	3.32	1.19	5.16	16.98
CENTRAL NEBRASKA						
Kearney	3.78	3.13	3.66	.92	6.85	18.34
Holt	.80	4.25	3.28	.90	2.18	11.41
Lincoln	.72	1.95	3.09	.59	2.35	8.70
Cherry	.59	3.42	3.15	1.95	4.45	13.56
Average	1.47	3.19	3.29	1.09	3.96	13.00
WESTERN NEBRASKA						
Grant	.49	2.15	2.32	2.77	3.40	11.13
Dawes	1.15	4.97	3.44	2.38	.82	12.76
Kimball	1.07	3.70	.93	2.75	1.61	10.06
Average	.90	3.61	2.23	2.63	1.94	11.32

SUMMARY OF CONDITIONS WHERE CORN TYPES WERE STUDIED

NORMAL REGIONAL DIFFERENCES

The approximate normal environmental differences between the various localities where the following corn type survey was

made are compiled in Table 2 from the preceding charts. Striking regional climatic differences will be noted.

TEMPERATURE AND RAINFALL DURING 1915 AND 1916

Tables 3 to 6 show the temperature and rainfall during the crop growing season for localities where corn types were studied. A knowledge of these conditions may help account for certain

TABLE 5.—*Mean Temperature During Four Spring and Summer Months in Regions Where Corn Adaptation Studies Were Located. 1915.*

Location	Mean Temperature				
	May	June	July	August	Average
County (1)	*Degrees F.* (2)	*Degrees F.* (3)	*Degrees F.* (4)	*Degrees F.* (5)	*Degrees F.* (6)
		EASTERN NEBRASKA			
Richardson	61.6	69.8	72.8	69.6	68.4
Washington	58.4	66.0	70.0	65.9	65.1
Thurston	57.2	65.6	69.6	65.2	64.4
Lancaster	59.0	67.2	71.7	67.9	66.4
Nuckolls	60.0	67.4	72.4	69.0	67.2
Average	59.2	67.2	71.3	67.5	66.3
		CENTRAL NEBRASKA			
Kearney	57.5	65.6	71.6	68.6	65.8
Holt	53.8	63.1	67.2	66.4	62.6
Lincoln	55.2	63.8	69.4	68.2	64.1
Cherry	52.7	62.0	67.6	66.4	62.2
Average	54.8	63.6	68.9	67.4	63.7
		WESTERN NEBRASKA			
Grant*	52.7	61.4	67.0	66.2	61.8
Dawes	53.2	61.6	66.9	68.0	62.4
Kimball	51.8	60.0	66.5	66.0	61.1
Average	52.5	61.0	66.8	66.7	61.8

*Temperature data in Grant County were not available for 1915, and data from Arthur County, bordering on the south, have been supplied.

apparent inconsistencies in the comparative plant characters. The year 1915 especially was much wetter than normal. Relatively, the seasonal precipitation for Lincoln County in 1916 was unduly low, which accounts for the outstandingly low plant development there that year.

TABLE 6.—*Mean Temperature During Four Spring and Summer Months in Regions Where Corn Adaptation Studies Were Located. 1916.*

Location	Mean Temperature				
	May	June	July	August	Average
County (1)	*Degrees F.* (2)	*Degrees F.* (3)	*Degrees F.* (4)	*Degrees F.* (5)	*Degrees F.* (6)
EASTERN NEBRASKA					
Richardson	64.4	70.3	81.9	78.7	73.8
Cass	62.0	66.5	79.6	74.7	70.7
Thurston	60.2	64.9	80.1	73.2	69.6
Lancaster	62.2	67.8	82.1	75.8	72.0
Nuckolls	56.8	63.8	81.0	76.8	69.6
Average	61.1	66.7	80.9	75.8	71.1
CENTRAL NEBRASKA					
Kearney	60.7	66.2	80.0	74.4	70.3
Holt	55.0	63.7	79.5	72.8	67.7
Lincoln	58.2	64.6	80.0	74.0	69.2
Cherry	55.0	62.2	79.2	71.2	66.9
Average	57.2	64.2	79.7	73.1	68.5
WESTERN NEBRASKA					
Grant	52.5	60.0	70.5	67.6	62.6
Dawes	54.6	62.8	78.0	69.9	66.3
Kimball	53.3	63.0	74.2	68.3	64.7
Average	53.5	61.9	74.2	68.6	64.5

THE CORN TYPES SURVEY OF NEBRASKA

TWO CLASSES OF INVESTIGATIONS

Data having been presented to show the widely different growing conditions in various regions of the State, we may proceed to the comparison of corn types which are found adapted to these conditions. The plant characters were determined by detail measurments, the results of which are summarized in tabular form.

The corn types survey may be divided into two main sorts of investigation: (1) Native corn types grown in their home environment, and (2) native corn types grown out of their home environment. The types studied in both cases represent native corns from twelve different parts of the State. Such localities, Figure 9, were selected that most regional conditions in Nebraska might be represented. The localities may be re-

grouped to represent more general regional areas. In the tables, the data are assembled by localities into eastern, central, and western Nebraska groups.

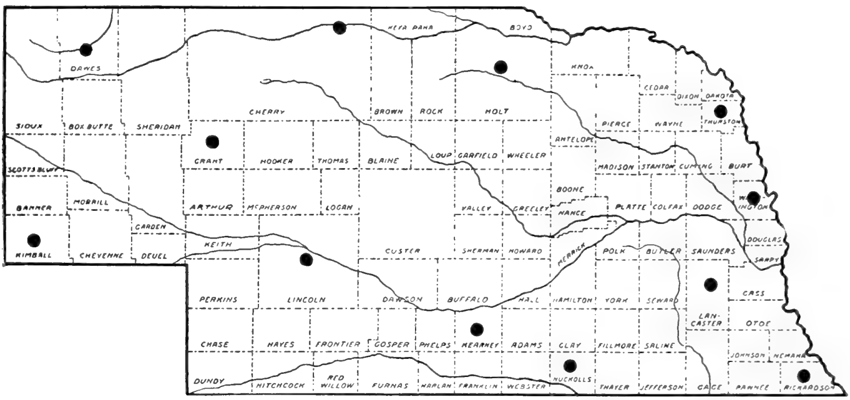

Fig. 9—Sources of native corn types used in these investigations, 1915 and 1916.

NATIVE CORN TYPES GROWN AT HOME

MORPHOLOGICAL CHARACTERS

METHODS OF STUDY

During the years 1915 and 1916, detailed measurements were made of representative corn types grown in twelve counties scattered thruout the State. On an average, four representative fields were chosen in each county, and ten successive plants measured in a representative part of each field. The morphological characters measured were: (1) Height of stalk, (2) height of ear, (3) leaf area, (4) grain weight, (5) ear weight, (6) stover weight, (7) total plant weight, (8) shelling per cent, (9) leaf area per gram dry matter produced, (10) length of ear, (11) circumference of ear, (12) length of kernel, (13) width of kernel. Bags were kept in the field for systematically gathering the dry leaves of the selected plants from time to time in order to conserve all the plant substance. Leaf areas were determined by E. G. Montgomery's formula, i.e. ¾ × length × maximum width.† At maturity all plants were harvested and assembled for uniform air drying in a warm room for several months in order that weights might be comparable.

RESULTS

The data for 1915 and 1916 are given separately in Tables 7 and 8. The two years are averaged in Table 9. In Table 10 the regional differences in plant characters are made more

†Montgomery, E. G., 1911, Correlation studies of corn, Nebr. Agr. Exp. Sta. 24th Annual Report, p. 113.

readily visible by giving relative rather than actual figures. In this table the ratios are based upon the measurments for Richardson County corn as 100 per cent. Richardson County, being situated in the extreme southeastern part of the State, has normally the longest growing season, highest temperature, and greatest precipitation in the State.

By comparing the results for Richardson and Kimball Counties the reaction of corn types adapted to the two most extreme environments may be observed. Based on Richardson County corn measurments as 100 per cent, relative values for Kimball County were as follows: (1) Height of stalk, 60; (2) height of ear, 30; (3) leaf area, 37; (4) stover weight, 41; (5) ear weight, 28; (6) total dry matter, 33; (7) grain weight, 25; (8) shelling per cent, 89; (9) leaf area per gram dry matter, 108; (10) ear length, 67; (11) ear circumference, 80; (12) kernel length, 76; (13) kernel width, 106; and (14) kernel weight, 58. Other counties may be compared in a similar manner. With some irregularities which are due perhaps in part to low frequency of plants studied, the data for the various counties suggest that the more adverse the conditions, the more dwarfish is the growth habit of adapted types of corn.

With the twelve counties under observation, grouped into three State regions from east to west (Table 11), the same principles are brought out. Based on eastern Nebraska measurements as 100 per cent, relative values for eastern, central and western Nebraska were respectively as follows: (1) Height of stalk, 100, 78, and 68; (2) height of ear, 100, 66, and 40; (3) leaf area, 100, 67, and 44; (4) stover weight, 100, 74, and 50; (5) ear weight, 100, 67, and 39; (6) total dry matter, 100, 70, and 44; (7) grain weight, 100, 63, and 35; (8) shelling per cent, 100, 95, and 89; (9) leaf area per gram dry matter, 100, 95 and 98; (10) ear length, 100, 90, and 79; (11) ear circumference, 100, 94, and 84; (12) kernel length, 100, 93, and 84; (13) kernel width, 100, 103, and 101; (14) kernel weight, 100, 85, and 61.

HISTOLOGICAL CHARACTERS

METHODS OF STUDY

Since the leaf is the seat of food synthesis and of transpiration, it would appear that the most important special histological adaptations, if any, would occur there. Therefore, rather detailed microscopic leaf studies were made for all the plants harvested in seven of the counties previously reported.

At the time of measuring the leaf area, about two weeks after tasseling, a leaf sample for sectioning was taken, by means

TABLE 7.—*Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. 1915.*

Where grown	Plant measurements				Dry matter			Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA														
Richardson	8.7	3.2	1,293	216	323	539	275	85	2.4	8.1	6.7	.56	.31	.313
Washington	9.6	4.1	1,386	227	307	534	258	84	2.6	8.2	7.0	.56	.32	.299
Thurston	7.7	2.9	1,048	157	165	322	132	80	3.3	7.0	6.0	.49	.31	.200
Lancaster	8.3	4.3	1,222	221	195	416	164	84	2.9	7.0	6.0	.45	.31	.222
Nuckolls	7.4	2.8	1,174	189	261	450	219	84	2.6	7.5	6.5	.42	.36	.332
Average	8.3	3.5	1,225	203	250	452	210	83	2.8	7.6	6.4	.50	.32	.273
CENTRAL NEBRASKA														
Kearney	7.1	2.9	899	168	214	382	178	83	2.4	7.3	6.4	.51	.32	.256
Holt	6.6	2.3	746	112	100	212	172	72	3.5	6.1	5.5	.41	.32	.163
Lincoln	6.4	2.3	724	149	193	342	154	80	2.0	7.2	6.0	.47	.34	.273
Cherry	6.3	2.0	692	128	116	244	87	75	2.9	6.1	5.5	.42	.34	.192
Average	6.6	2.4	765	139	156	295	123	77	2.7	6.7	5.8	.45	.33	.221
WESTERN NEBRASKA														
Grant	6.1	2.1	746	142	70	212	42	60	3.5	6.3	5.4	.43	.28	.102
Dawes	6.1	1.8	601	108	99	207	72	73	2.9	6.0	5.6	.41	.32	.160
Kimball	5.2	1.1	470	106	79	185	56	71	2.5	5.3	5.4	.41	.36	.188
Average	5.8	1.7	606	119	83	202	57	68	3.0	5.9	5.5	.42	.32	.150

TABLE 8.—*Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. 1916.*

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA														
Richardson..	9.2	3.9	1,274	221	274	495	233	85	2.6	7.9	6.5	.50	.32	.327
Washington..	8.6	3.9	1,269	222	282	504	242	86	2.5	8.3	6.3	.50	.30	.308
Thurston....	7.5	3.3	1,138	176	162	338	133	82	3.4	6.6	5.7	.46	.30	.254
Lancaster....	7.4	3.9	1,295	160	208	368	177	85	3.5	7.1	5.8	.44	.30	.290
Nuckolls....	6.3	2.8	1,122	197	135	332	108	80	3.4	5.9	5.2	.47	.33	.309
Average...	7.8	3.6	1,220	195	212	407	179	84	3.1	7.2	5.9	.47	.31	.289
CENTRAL NEBRASKA														
Kearney.....	6.8	3.2	1,029	219	171	390	142	83	2.6	6.8	6.0	.48	.31	.254
Holt........	6.8	2.3	973	149	181	330	147	81	2.9	7.0	6.0	.45	.33	.257
Lincoln......	5.1	1.7	793	124	124	248	99	80	3.2	6.2	5.4	.44	.32	.281
Cherry......	5.4	1.7	699	128	142	270	114	80	2.6	6.3	5.4	.44	.32	.271
Average...	6.0	2.2	873	155	154	309	125	81	2.8	6.6	5.7	.45	.32	.266
WESTERN NEBRASKA														
Grant.......	4.9	1.2	504	76	80	156	62	78	3.2	5.7	4.3	.37	.32	.186
Dawes......	5.0	1.2	467	89	121	210	98	81	2.2	6.1	5.3	.43	.32	.224
Kimball.....	5.7	1.0	468	71	89	160	72	81	2.9	5.5	5.2	.40	.31	.183
Average...	5.2	1.1	480	79	97	176	77	80	2.8	5.8	4.9	.40	.32	.198

TABLE 9.—*Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. (Average for 1915 and 1916.)*

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA														
Richardson	8.95	3.50	1,283.5	218.5	298.5	517.0	254.0	85	2.50	8.00	6.6	.530	.315	.3200
Washington	9.10	4.00	1,327.5	224.5	294.5	519.0	250.0	85	2.55	8.25	6.65	.530	.310	.3035
Thurston	7.60	3.10	1,093.0	166.5	163.5	330.0	132.5	81	3.3	6.80	5.85	.475	.305	.2270
Lancaster	7.80	4.10	1,258.5	190.5	201.5	392.0	170.5	84.5	3.2	7.05	5.90	.445	.305	.2560
Nuckolls	6.80	2.80	1,148.0	193.0	198.0	391.0	163.5	82	3.0	6.70	5.85	.445	.345	.3205
Average	8.05	3.50	1,222.1	198.6	231.2	429.8	194.1	83.5	2.89	7.36	6.17	.485	.316	.2854
CENTRAL NEBRASKA														
Kearney	6.90	3.05	964.0	193.5	192.5	386.0	160.0	83	2.50	7.05	6.20	.495	.315	.255
Holt	6.70	2.30	859.5	130.5	140.5	271.0	107.4	76.5	3.10	6.55	5.75	.430	.325	.210
Lincoln	5.70	2.00	758.5	136.5	158.5	295.0	126.8	80	2.60	6.70	5.70	.455	.330	.277
Cherry	5.80	1.85	695.5	128.0	129.0	257.0	100.5	77.5	2.70	6.20	5.45	.430	.330	.2315
Average	6.27	2.30	819.4	147.1	155.1	302.2	123.2	79.2	2.75	6.62	5.77	.452	.325	.2434
WESTERN NEBRASKA														
Grant	5.50	1.65	625.0	109.0	75.0	184.0	52.0	69	3.3	6.0	4.85	.400	.300	.1440
Dawes	5.50	1.50	534.0	98.5	110.0	208.5	85.0	77	2.5	6.05	5.45	.420	.320	.1920
Kimball	5.40	1.05	469.0	88.5	84.0	172.5	64.0	76	2.7	5.40	5.30	.405	.335	.1855
Average	5.47	1.40	542.7	98.7	89.7	188.4	67.0	74	2.83	5.82	5.20	.408	.318	.1738

Data in column 10 are the average of ratios rather than the ratio of averages.

TABLE 10.—*Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. The results for the various counties are here expressed in per cent of the results for Richardson County. (Average for 1915 and 1916.)**

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Per cent* (2)	*Per cent* (3)	*Per cent* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	*Per cent* (8)	*Per cent* (9)	*Per cent* (10)	*Per cent* (11)	*Per cent* (12)	*Per cent* (13)	*Per cent* (14)	*Per cent* (15)
EASTERN NEBRASKA														
Richardson	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Washington	102	114	103	103	99	100	98	100	102	103	101	100	98	95
Thurston	85	89	85	76	55	64	52	95	132	85	89	90	97	71
Lancaster	87	117	98	87	67	76	67	99	128	88	89	84	97	80
Nuckolls	76	80	89	88	66	76	64	96	120	84	89	84	109	100
CENTRAL NEBRASKA														
Kearney	77	87	75	89	64	75	63	98	100	88	94	93	100	80
Holt	75	66	67	60	47	52	42	90	124	82	87	81	103	66
Lincoln	64	57	59	62	53	57	50	94	104	84	86	86	105	87
Cherry	65	53	54	59	43	50	40	91	108	77	83	81	105	72
WESTERN NEBRASKA														
Grant	62	47	49	50	25	36	20	81	132	75	73	75	95	45
Dawes	62	43	42	45	37	40	33	91	100	76	83	79	102	60
Kimball	60	30	37	40	28	33	25	89	108	67	80	76	106	58

*Data calculated from Table 9.

TABLE 11.—*Summary* of Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. (Average for 1915 and 1916.)*

Region in Nebraska where grown	Plant measurements: Height of stalk	Plant measurements: Height of ear	Plant measurements: Leaf area	Dry matter: Stover	Dry matter: Ear	Dry matter: Total	Dry matter: Grain	Shelling per cent	Leaf area per gram dry matter	Ear measurements: Length	Ear measurements: Circumference	Kernel measurements: Length	Kernel measurements: Width	Kernel measurements: Weight
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
ACTUAL VALUES														
	Feet	*Feet*	*Sq. In.*	*Grams*	*Grams*	*Grams*	*Grams*	*Per cent*	*Sq. In.*	*Inches*	*Inches*	*Inches*	*Inches*	*Grams*
Eastern (Av., 5 Co.)	8.05	3.50	1,222.1	198.6	231.2	429.8	194.1	83.5	2.89	7.36	6.17	.485	.316	.2854
Central (Av., 4 Co.)	6.27	2.30	819.4	147.1	155.1	302.2	123.2	79.2	2.75	6.62	5.77	.452	.325	.2434
Western (Av., 3 Co.)	5.47	1.40	542.7	98.7	89.7	188.4	67.0	74.0	2.83	5.82	5.20	.408	.318	.1738
RELATIVE VALUES														
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Eastern (Av., 5 Co.)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Central (Av., 4 Co.)	78	66	67	74	67	70	63	95	95	90	93	93	103	85
Western (Av., 3 Co.)	68	40	44	50	39	44	34	89	98	79	84	84	101	61

*Compiled from data in Table 9.

of a leaf punch, from the ear leaf of each plant measured. The point of sampling was at the widest part of the leaf midway between the mid-rib and leaf margin. A quantity of adjoining upper and lower epidermis was also removed and preserved. The leaf samples were preserved in absolute alcohol for later study. Previous experience had suggested that fairly comparable data might be secured by use of a similarly situated leaf from ten different plants of each variety. The number of plants studied from any one locality ranges from thirty to sixty, representing three to six different farms. The microscopic sections were made free-hand by using small corks and a sharp razor. An extensive method study proved that the use of only a few measurements would be unreliable because of the inconsistencies of leaf structure and, therefore, a large number of duplicate counts and measurements were made. An average of five varieties were studied microscopically for each of the seven counties. Four hundred transectional leaf measurements, and 160 epidermal counts and measurements were made for each variety, averaging a total of 2,000 per county in the former case and 800 in the latter. The following measurements were taken:

Leaf Thickness—This measurement includes the cuticle of each epidermal layer. Tissue immediately adjacent to the large vascular bundles was avoided.

Epidermal Thickness—The upper and lower epidermis were measured at the same point as the leaf thickness, including the cuticle.

Vascular Bundles—Counts were made of the number of vascular bundles in the cross-sections of the leaves.

Number of Stomata in a Unit Area—The number of stomata were counted in 100 microscopic fields for both the upper and lower epidermis of each type. The microscopic fields were chosen systematically in order that the results might be representative.

Length of Stoma and Stomatal Aperture—As far as possible, representative stomata were measured. It was at times with difficulty that the stomatal aperture was measured.

Length and Width of Epidermal Cells—Since these and all other microscopic measurements were made in eye piece spaces, it was necessary to convert them into microns.

RESULTS

The results of these histological studies are contained in Tables 12 and 13. The various localities are grouped into eastern, central, and western Nebraska regions. Since these studies involve only seven of the twelve counties used in studying the

preceding morphological adaptations, the morphological characters for these seven counties only are briefly summarized in Tables 14 and 15, in order that the histological data may be directly comparable with them.

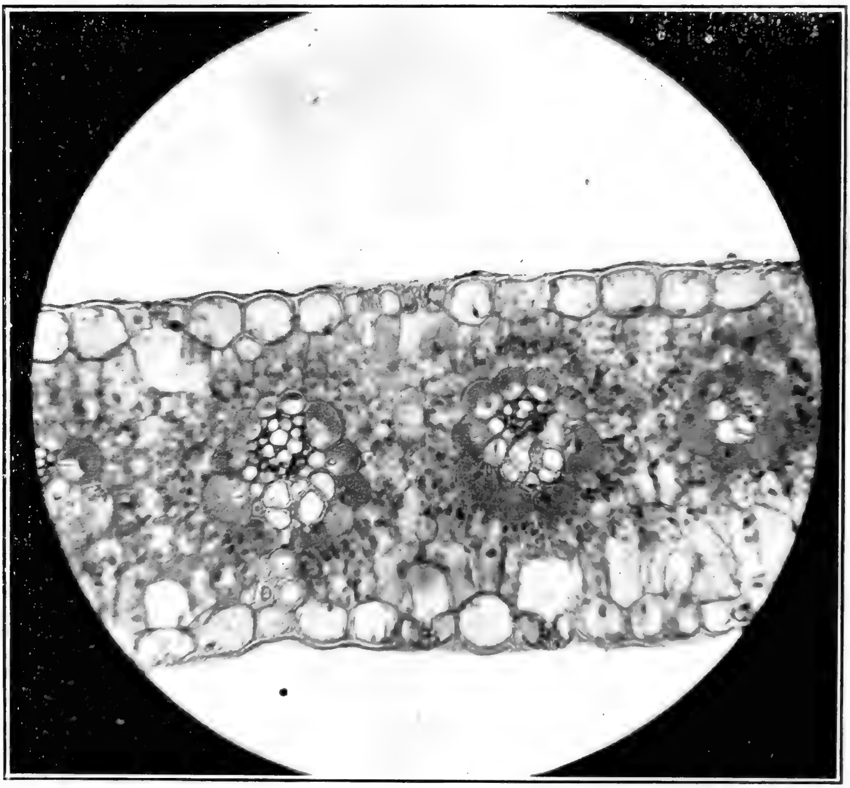

Fig. 10—Microphotograph of a cross-section of corn leaf, showing arrangement of vascular bundles, relative epidermal thickness, cuticle, and stomata. Enlarged 233 diameters.

In comparing native types grown under the two extreme conditions of Richardson County and Kimball County, it is observed that whereas the plant weight and leaf area of Kimball County corn are only 34 and 36 per cent as large respectively, the relative thickness of the leaf, and upper and lower epidermis are respectively 96, 97, and 97 per cent as great. The proportion of epidermal thickness to total leaf thickness is almost identical for both extreme types. The number of vascular bundles in one centimeter of cross-section of leaf is 4 per cent

greater for Kimball County corn. Based on Richardson County corn as 100 per cent, the relative number of stomata per square millimeter of epidermis, length of stoma, and length and width of epidermal cells of Kimball County corn were respectively 114, 90, 94, and 95 per cent. Similar comparisons between other counties may be made by a study of the tables. No adaptive structural differences are to be observed.

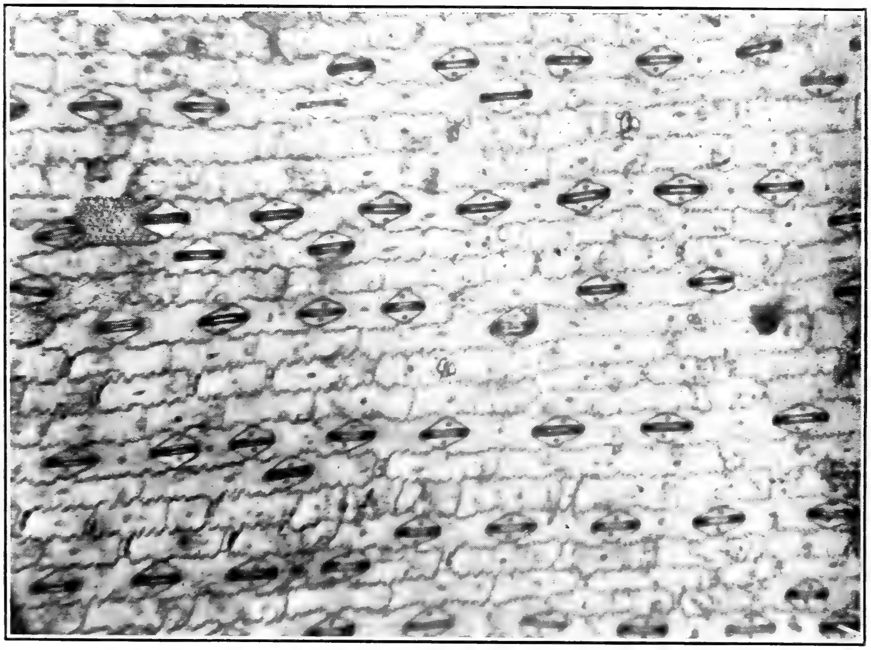

Fig. 11—Microphotograph of corn epidermis, showing epidermal cells, stomata, and stomatal apertures. Enlarged 116 diameters.

With the counties grouped into eastern, central, and western Nebraska, (Table 16), and the regional data based on eastern Nebraska as 100 per cent, we find that (1) the respective relative leaf thicknesses are, 100, 104, and 101; (2) thickness of upper epidermis, 100, 100, and 99; (3) lower epidermis, 100, 102, and 102; (4) number of vascular bundles in one centimeter of cross section, 100, 94, and 98; (5) average number of stomata per square millimeter epidermis, 100, 112, and 114; (6) average length of stomata, 100, 97, and 90; (7) average length of epidermal cell, 100, 83, and 87; and (8) average width of epidermal cell, 100, 98, and 99. The data suggest that while there is marked adaptation in morphological characters, there is no corresponding

TABLE 12.—*Histological Leaf Measurements of Native Corn Types Grown in Various Regions of Nebraska. 1915.*

Where grown	Thickness of			Per cent of total leaf thickness of			Number vascular bundles per cm. leaf width
	Leaf	Upper epidermis	Lower epidermis	Upper epidermis	Lower epidermis	Total epidermis	
County (1)	*Microns* (2)	*Microns* (3)	*Microns* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	(8)
EASTERN NEBRASKA							
Richardson....	230.3	34.9	29.6	15.2	12.8	28.0	63.8
Lancaster......	217.6	33.8	27.0	15.5	12.4	27.9	68.0
Thurston......	229.8	35.4	28.1	15.4	12.2	27.6	66.2
Average.......	225.9	34.7	28.2	15.3	12.4	27.8	66.0
CENTRAL NEBRASKA							
Lincoln........	236.6	34.3	28.4	14.5	12.0	26.5	59.7
Cherry........	232.4	35.4	29.6	15.3	12.7	28.0	63.9
Average.......	234.5	34.8	29.0	14.9	12.3	27.2	61.8
WESTERN NEBRASKA							
Dawes.........	234.7	35.4	28.7	15.1	12.2	27.3	62.7
Kimball.......	221.2	33.8	28.7	15.3	13.0	28.3	66.6
Average.......	227.9	34.6	28.7	15.2	12.6	27.8	64.6

Where grown	Number of stomata per sq. m. m.		Length of stoma		Length of epidermal cell		Width of epidermal cell	
	Upper epidermis	Lower epidermis	Upper epidermis	Lower epidermis	Upper epidermis	Lower epidermis	Upper epidermis	Lower epidermis
County (1)	(9)	(10)	*Microns* (11)	*Microns* (12)	*Microns* (13)	*Microns* (14)	*Microns* (15)	*Microns* (16)
EASTERN NEBRASKA								
Richardson.	69.9	86.2	49.2	47.5	96.7	87.3	35.7	37.4
Lancaster..	68.5	84.0	50.6	48.7	107.4	97.7	35.5	35.1
Thurston...	60.0	79.0	50.7	49.2	100.7	97.2	35.5	36.3
Average....	66.1	83.0	50.2	48.4	101.6	94.1	35.6	36.3
CENTRAL NEBRASKA								
Lincoln....	73.2	95.9	50.1	48.3	83.9	71.4	36.1	35.5
Cherry.....	75.2	91.7	47.1	45.4	84.3	85.4	35.6	33.3
Average....	74.2	93.8	48.6	46.8	84.1	78.4	35.8	34.4
WESTERN NEBRASKA								
Dawes.....	74.3	89.4	44.0	45.9	84.6	79.8	36.4	35.9
Kimball....	79.0	99.0	43.6	43.0	89.2	85.0	35.2	34.4
Average....	76.6	94.2	43.8	44.4	86.9	82.4	35.8	35.1

TABLE 13.—*Histological Leaf Measurements of Native Corn Types Grown in Various Regions of Nebraska. The Results for the Various Counties Are Here Expressed in Per Cent of the Results for Richardson County. 1915.*[1]

Where grown	Thickness of			Per cent of total leaf thickness of			Number vascular bundles per cm. leaf width
	Leaf	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis	Total epi-dermis	
County (1)	*Microns* (2)	*Microns* (3)	*Microns* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	(8)
EASTERN NEBRASKA							
Richardson	100	100	100	100	100	100	100
Lancaster	94	97	91	102	97	100	107
Thurston	100	101	95	101	95	99	104
CENTRAL NEBRASKA							
Lincoln	103	98	96	95	93	94	94
Cherry	101	101	100	101	99	100	100
WESTERN NEBRASKA							
Dawes	102	101	97	99	95	97	98
Kimball	96	97	97	101	102	101	104

Where grown	Number of stomata per sq. m. m.		Length of stoma		Length of epidermal cell		Width of epidermal cell	
	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis
County (1)	(9)	(10)	*Microns* (11)	*Microns* (12)	*Microns* (13)	*Microns* (14)	*Microns* (15)	*Microns* (16)
EASTERN NEBRASKA								
Richardson	100	100	100	100	100	100	100	100
Lancaster	98	97	103	102	111	112	99	94
Thurston	86	92	103	104	104	111	99	97
CENTRAL NEBRASKA								
Lincoln	105	111	102	102	87	82	101	95
Cherry	108	106	96	96	87	98	100	89
WESTERN NEBRASKA								
Dawes	106	104	89	97	87	91	102	96
Kimball	113	115	89	90	92	97	99	92

[1]Data calculated from Table 12.

TABLE 14.—*Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. 1915.*[1]

Where grown	Height of stalk	Height of ear	Leaf area	Total weight of plant	Weight of ear	Shelling per cent	Length of ear
County (1)	*Feet* (2)	*Feet* (3)	*Sq. in.* (4)	*Grams* (5)	*Grams* (6)	*Per cent* (7)	*Inches* (8)
			EASTERN NEBRASKA TYPES				
Richardson..	8.7	3.2	1,293	539	323	85	8.1
Lancaster....	8.3	4.3	1,222	416	195	84	7.0
Thurston....	7.7	2.9	1,048	322	165	80	7.0
Average.....	8.2	3.5	1,188	426	228	83	7.4
			CENTRAL NEBRASKA TYPES				
Lincoln......	6.4	2.3	724	342	193	80	7.2
Cherry......	6.3	2.0	692	244	116	75	6.1
Average.....	6.3	2.1	708	293	154	77	6.6
			WESTERN NEBRASKA TYPES				
Dawes......	6.1	1.8	601	207	99	73	6.0
Kimball.....	5.2	1.1	470	185	79	71	5.3
Average.....	5.6	1.4	535	196	89	72	5.6

[1]A separate table is made for these seven counties in order that the summary data for the three larger regional sub-divisions may be entirely comparable with corresponding histological data of table 12, which includes only these seven rather than all twelve counties.

TABLE 15.—*Plant Characteristics of Native Corn Types Grown in Various Regions of Nebraska. The Results for the Various Counties Are Here Expressed in Per Cent of the Results for Richardson County. 1915.*[1]

Where grown	Height of stalk	Height of ear	Leaf area	Total weight of plant	Weight of ear	Shelling per cent	Length of ear
County (1)	*Per cent* (2)	*Per cent* (3)	*Per cent* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	*Per cent* (8)
			EASTERN NEBRASKA				
Richardson...	100	100	100	100	100	100	100
Lancaster.....	95	134	94	77	60	99	86
Thurston.....	88	91	81	60	51	94	86
			CENTRAL NEBRASKA				
Lincoln.......	74	72	56	63	60	94	89
Cherry.......	72	62	54	45	36	88	75
			WESTERN NEBRASKA				
Dawes........	70	56	46	38	31	86	74
Kimball......	60	34	36	34	24	84	65

[1]Data calculated from Table 14.

TABLE 16.—*Summary of Histological and Morphological Characteristics of Native Corn Types Grown in Various Regions of Nebraska. The Results for Central and Western Nebraska Are Here Expressed in Per Cent of the Results for Eastern Nebraska. 1915.*[1]

Region where grown	Thickness of: Leaf	Thickness of: Upper epidermis	Thickness of: Lower epidermis	Per cent of total leaf thickness of: Upper epidermis	Per cent of total leaf thickness of: Lower epidermis	Per cent of total leaf thickness of: Total epidermis	Number vascular bundles per cm. leaf width
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Eastern Nebraska......	100	100	100	100	100	100	100
Central Nebraska......	104	100	103	97	99	98	94
Western Nebraska.....	101	99	102	99	102	100	98

Region where grown	Number of stomata per sq. m. m.: Upper epidermis	Number of stomata per sq. m. m.: Lower epidermis	Length of stoma: Upper epidermis	Length of stoma: Lower epidermis	Length of epidermal cell: Upper epidermis	Length of epidermal cell: Lower epidermis	Width of epidermal cell: Upper epidermis	Width of epidermal cell: Lower epidermis
(1)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Eastern Nebraska.	100	100	100	100	100	100	100	100
Central Nebraska.	112	113	97	97	84	83	101	95
Western Nebraska.	116	113	87	92	86	88	101	97

Region where grown	Height of stalk	Height of ear	Leaf area	Total weight of plant	Weight of ear	Shelling per cent	Length of ear
(1)	(17)	(18)	(19)	(20)	(21)	(22)	(24)
Eastern Nebraska.	100	100	100	100	100	100	100
Central Nebraska.	77	60	60	69	68	93	89
Western Nebraska	68	40	45	46	39	87	76

[1]Data calculated from Tables 12 and 14.

significant histological adaptation. Practically speaking, the types adapted to the driest one-third of the State have developed no less succulent leaf, and no thicker epidermis resulting in reduced opportunity for water evaporation. The actual number of stomata per square millimeter is 14 per cent greater for western than for eastern Nebraska corn. This would seem to increase the opportunity for evaporation.

However, the greater number of stomata would seem to be offset by a reduction of 10 per cent in length. The fact that this 10 per cent reduction in length of stomata is accompanied by a 13 per cent reduction in length of the epidermal cell, which reduction would in no way be associated with water economy,

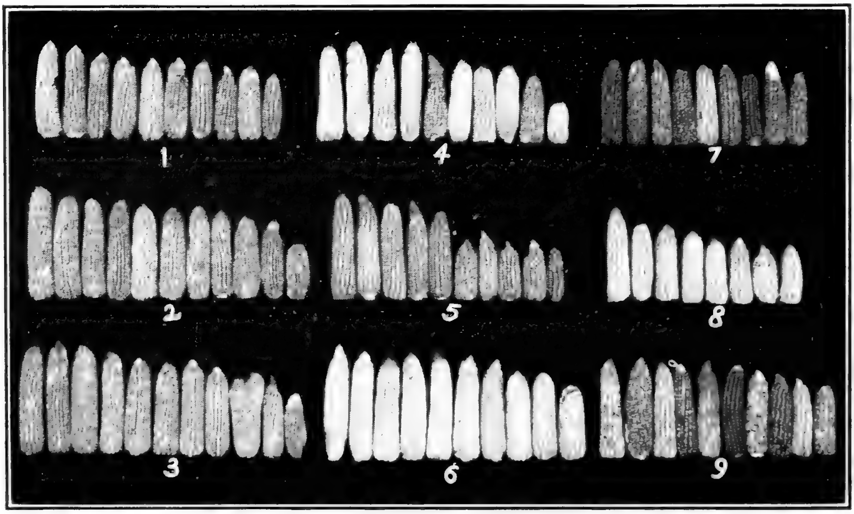

Fig. 12—Native corn types from nine regional areas of the state, grown comparably in southeastern Nebraska. (Lancaster County.)
Each group of ears is the harvest from ten successive representative plants of each type. The seed from all sources matured well when grown in Lancaster County.
(1) Thurston County corn, (2) Lancaster County corn, (3) Richardson County corn, (4) Holt County corn, (5) Kearney County corn, (6) Nuckolls County corn, (7) Cherry County corn, (8) Kimball County corn, (9) Lincoln County corn.

suggests that neither this stomatal shortening nor increased number of stomata per unit area are adaptive in nature. They are perhaps rather the combined result of less favorable growth conditions and of an inherent smaller cell development which is associated with the smaller plant growth habit of the earlier types.

NATIVE CORN TYPES GROWN OUT OF THEIR HOME ENVIRONMENT

In these tests native seed corn was collected from each of the twelve localities within the State previously considered. These twelve lots of seed were distributed and grown comparatively in five of the same twelve localities, representing a wide range of conditions. Thus, in each test twelve types from various parts of the State were compared with each other in five different environments, one of the types in each case being native home-grown seed. Approximately 300 plants were grown from each type. Care was taken to eliminate the effects of variety plat competition by planting extra discard rows between unlike types.

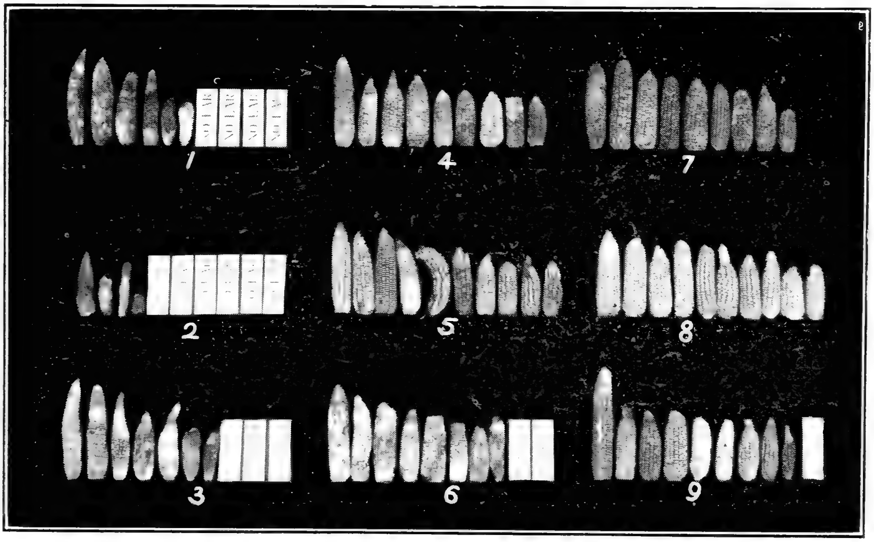

Fig. 13—Native corn types from nine regional areas of the state, grown comparably in extreme western Nebraska. (Kimball County.)
Each group of ears is the product of ten successive representative plants of each type. The native Kimball County type is the only one which fully matured when grown in Kimball County.
(1) Thurston County corn, (2) Lancaster County corn, (3) Richardson County corn, (4) Holt County corn, (5) Kearney County corn, (6) Nuckolls County corn, (7) Cherry County corn, (8) Kimball County corn, (9) Lincoln County corn.

Due perhaps in part to local seasonal abnormalities, and in part to the use of relatively few plants, a number of apparent inconsistencies occur. However, the nature of the data would seem to be such as to justify general conclusions.

Morphological characters were recorded for all twelve types grown in each of the five tests. Histological measurements were made for the twelve types grown only in the most extreme regions, namely Lancaster County and Kimball County.

MORPHOLOGICAL CHARACTERS

The same general methods were employed and the same notes taken as in the previous investigation, (p. 22). The tabulated data for each type grown in each locality are the mean results for ten successive plants in a representative part of each plat. The detailed results are recorded in Tables 17 to 21, and are summarized in Tables 22 to 25. A careful study of the tables will show the relative growths made by (1) corn of the same source when grown in different regions, and (2) corn of different sources when grown in single locality.

In order to avoid a too tedious discussion, the reader is referred for most comparisons directly to the tables, and especially Tables 22 to 25. Only a few of the possible comparisons will be brought out in this discussion.

Native Lancaster County corn grew only 80 per cent as tall when grown in Kimball County as when grown in Lancaster County. Other relative values for Kimball County grown corn were: Height of ear, 52 per cent; leaf area, 78 per cent; stover weight, 62 per cent; ear weight, 1 per cent; total dry matter, 26 per cent; grain weight, 0.8 per cent; shelling percentage, 63; amount of leaf area per unit dry matter, 300 per cent; length of ear, 40 per cent; and ear circumference, 44 per cent. This illustrates the reduction in vegetative growth and even more extreme grain reduction when corn is moved to a less favorable region.

On the other hand, when corn is moved to a more favorable region, its vegetative growth and grain production are considerably increased. To illustrate, when native Kimball County corn was grown both at home and in Lancaster County the ratios of the latter to the former were: Plant height, 129 per cent; ear height, 154 per cent; leaf area, 140 per cent; stover weight, 161 per cent; ear weight, 135 per cent; total dry matter, 146 per cent; grain weight, 131 per cent; shelling percentage, 97; amount of leaf area per unit dry matter, 96 per cent; ear length, 113 per cent; and ear circumference, 107 per cent.

When home grown seed was planted in these two extreme localities, the relative values based on Lancaster County plants as 100 per cent, were as follows: Stalk height, 100 and 56; ear height, 100 and 26; leaf area, 100 and 30; stover weight, 100 and 35; ear weight, 100 and 33; total dry matter, 100 and 34;

TABLE 17.—*Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Southeastern Nebraska. (Lancaster County) 1916.*

Source of Seed	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA TYPES														
Richardson	8.3	4.2	1,298	220	286	506	249	87	2.6	7.8	5.9	.50	.27	.276
Lancaster	7.5	4.2	1,414	193	276	469	240	87	3.0	7.8	6.4	.51	.28	.289
Washington	7.8	4.3	1,407	215	209	424	176	85	3.5	7.4	6.2	.48	.28	.280
Thurston	7.4	3.3	1,209	174	197	371	165	84	3.2	7.0	6.1	.47	.31	.280
Nuckolls	7.5	3.4	1,459	217	283	500	229	81	2.9	8.1	6.8	.48	.33	.347
Average	7.7	3.9	1,357	204	250	454	212	85	3.0	7.6	6.3	.49	.29	.294
CENTRAL NEBRASKA TYPES														
Kearney	6.9	3.5	1,259	185	179	364	149	83	3.4	6.7	6.0	.48	.33	.331
Holt	6.8	3.2	1,219	202	196	398	153	78	3.0	7.0	6.3	.46	.33	.314
Lincoln	6.1	3.1	849	167	197	364	160	81	2.2	7.4	5.8	.45	.35	.316
Cherry	6.0	2.8	833	155	166	321	131	79	2.6	6.4	5.9	.43	.33	.327
Average	6.4	3.1	1,040	177	184	361	148	80	2.8	6.9	6.0	.45	.33	.344
WESTERN NEBRASKA TYPES														
Kimball	5.4	1.7	594	108	123	231	96	78	2.6	6.2	5.8	.43	.34	.307
Grant	5.7	2.0	775	161	157	318	129	82	2.4	6.7	5.6	.45	.34	.293
Average	5.5	1.8	684	134	140	274	112	80	2.5	6.4	5.7	.44	.34	.300

TABLE 18.—*Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Northeastern Nebraska. (Thurston County) 1916.*

Source of Seed	Plant measurements			Stover	Dry matter			Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area		Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA TYPES														
Richardson	8.9	4.4	1,502	184	175	359	147	84	4.2	7.5	5.9	.45	.27	.205
Lancaster	8.4	4.4	1,320	208	171	379	145	85	3.5	6.5	6.0	.48	.29	.237
Washington	8.8	4.6	1,596	233	133	366	112	84	4.4	6.3	4.8	.48	.28	.251
Thurston	7.8	3.5	985	169	152	321	125	82	3.1	5.8	5.5	.44	.29	.245
Nuckolls	8.4	4.5	1,330	200	140	340	115	82	3.9	6.0	5.7	.46	.32	.267
Average	8.5	4.3	1,346	199	154	353	129	83	3.8	6.4	5.6	.46	.29	.241
CENTRAL NEBRASKA TYPES														
Kearney	7.4	3.4	1,086	142	146	288	128	88	3.8	5.8	5.6	.46	.30	.280
Holt	7.2	3.2	1,081	158	144	302	122	85	3.6	5.5	5.8	.48	.31	.279
Lincoln	7.6	3.2	939	151	119	270	100	84	3.5	5.2	5.3	.43	.33	.307
Cherry	7.1	3.0	936	119	135	254	115	85	3.7	5.5	5.1	.43	.33	.295
Average	7.3	3.2	1,010	142	136	278	116	85	3.6	5.5	5.4	.45	.32	.290
WESTERN NEBRASKA TYPES														
Kimball	6.4	2.3	647	111	125	236	101	81	2.7	5.4	5.6	.42	.36	.326
Grant	6.4	2.4	808	104	143	247	117	82	3.3	5.9	5.7	.43	.34	.296
Dawes	6.2	2.3	717	91	113	204	95	84	3.5	5.5	5.4	.41	.32	.260
Average	6.3	2.3	724	102	127	229	104	82	3.2	5.6	5.6	.42	.34	.294

TABLE 19.—*Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in North-central Nebraska. (Cherry County) 1916.*

Source of Seed	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA TYPES														
Richardson	6.6	2.6	1,094	167	143	310	113	79	3.5	6.9	5.7	.41	.25	.126
Lancaster	7.1	2.9	959	165	130	295	94	72	3.2	6.7	5.6	.40	.25	.085
Washington	7.4	2.7	991	163	123	286	89	72	3.5	7.9	5.5	.40	.27	.126
Thurston	6.8	2.2	891	145	163	308	130	80	2.9	7.2	5.8	.44	.30	.175
Nuckolls	7.3	3.1	1,066	185	141	326	109	77	3.2	7.5	6.0	.43	.30	.157
Average	7.0	2.7	1,000	165	140	305	107	76	3.3	7.2	5.7	.42	.27	.134
CENTRAL NEBRASKA TYPES														
Kearney	6.3	2.0	820	156	94	250	64	68	3.3	7.3	5.5	.41	.31	.176
Holt	6.4	2.1	954	153	149	302	119	80	3.1	6.4	5.8	.44	.32	.214
Lincoln	6.4	2.1	840	143	146	289	112	77	2.9	7.6	5.8	.42	.32	.215
Cherry	5.8	1.7	624	121	151	272	121	80	2.2	7.3	5.5	.41	.32	.209
Average	6.2	2.0	809	143	135	278	104	76	2.8	7.1	5.6	.42	.32	.203
WESTERN NEBRASKA TYPES														
Kimball	4.7	1.0	376	70	109	179	88	81	2.0	6.2	5.8	.41	.31	.216
Grant	5.4	1.3	587	106	142	248	112	79	2.3	6.1	5.8	.32	.43	.224
Dawes	5.3	1.1	440	65	131	196	110	84	2.2	5.5	5.3	.41	.32	.276
Average	5.1	1.1	468	80	127	207	103	81	3.3	5.9	5.6	.38	.35	.239

TABLE 20.—*Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in West-central Nebraska. (Lincoln County) 1916.*

Source of Seed	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circum-ference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA TYPES														
Richardson	6.0	2.7	1,074	128	68	197	57	84	5.4	5.6	5.3	.42	.27	.201
Lancaster	5.7	2.4	1,061	133	75	208	62	83	5.1	5.4	5.1	.45	.29	.228
Washington	6.0	2.8	1,150	150	47	197	39	83	5.8	3.8	4.9	.46	.29	.246
Thurston	5.5	2.1	941	142	64	206	51	80	4.6	4.2	4.9	.41	.27	.225
Nuckolls	5.4	2.0	1,002	130	98	228	76	78	4.4	5.6	5.3	.45	.30	.282
Average	5.7	2.4	1,046	137	70	207	57	82	5.1	4.9	5.1	.44	.28	.236
CENTRAL NEBRASKA TYPES														
Kearney	5.2	1.8	836	111	110	221	89	81	3.8	6.4	5.5	.46	.33	.392
Holt	4.6	1.6	922	105	45	150	36	81	6.1	4.9	5.2	.41	.32	.273
Lincoln	5.1	1.7	792	118	119	237	92	77	3.3	5.7	5.1	.43	.31	.266
Cherry	4.7	1.4	762	108	76	184	62	81	4.1	5.2	4.6	.41	.33	.264
Average	4.9	1.6	828	110	87	197	70	80	4.4	5.5	5.1	.43	.32	.299
WESTERN NEBRASKA TYPES														
Kimball	4.2	1.2	472	73	62	135	50	80	3.4	5.0	5.0	.40	.35	.308
Grant	4.2	1.3	563	105	54	159	42	78	3.5	4.4	4.8	.39	.33	.278
Dawes	4.2	1.1	525	74	58	132	46	79	4.0	4.1	4.9	.41	.34	.288
Average	4.2	1.2	520	84	58	147	46	79	3.6	4.5	4.9	.40	.34	.291

TABLE 21.—*Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Extreme Western Nebraska. (Kimball County) 1916.*

Source of Seed	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements[1]		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA TYPES														
Richardson	6.9	3.0	1,050	128	24	152	18	74	6.9	5.8	3.2	.35	.23	.059
Lancaster	6.0	2.2	1,100	119	3	122	2	55	9.0	3.1	2.8	......	......	......
Washington	7.4	3.0	1,140	143	17	160	7	41	7.1	6.0	4.8	.34	.25	.082
Thurston	5.5	3.1	563	100	22	122	15	70	4.6	6.3	4.4	.28	.22	.081
Nuckolls	6.0	2.0	1,042	156	36	192	28	77	5.4	6.1	5.1	.35	.28	.081
Average	6.4	2.7	979	129	20	149	14	63	6.6	5.5	4.1	.26[2]	.24[2]	.076[2]
CENTRAL NEBRASKA TYPES														
Kearney	5.9	1.9	718	102	70	172	54	77	4.2	5.5	5.1	.36	.28	.116
Holt	5.7	1.9	759	108	49	157	33	68	4.9	5.5	5.3	.32	.27	.099
Lincoln	5.1	1.6	491	76	55	131	40	73	3.7	5.3	4.9	.34	.28	.124
Cherry	4.9	1.4	536	73	79	152	62	78	3.5	5.4	5.2	.36	.29	.148
Average	5.4	1.7	626	90	63	153	47	74	3.9	5.4	5.1	.34	.28	.122
WESTERN NEBRASKA TYPES														
Kimball	4.2	1.1	425	67	91	158	73	80	2.7	5.5	5.4	.39	.30	.197
Grant	4.9	1.6	426	77	53	130	37	70	3.3	4.2	4.4	.34	.25	.174
Dawes	4.5	1.0	330	65	76	141	56	74	2.3	4.5	4.7	.35	.28	.144
Average	4.5	1.2	394	70	73	143	55	75	2.8	4.7	4.8	.36	.28	.172

[1]Ear measurements in this and similar tables are the average for the ears produced, whereas, the ear and grain yield per plant is the mean for the entire number of plants.

[2]Average for four counties only.

TABLE 22.—*Summary of Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Interchanged with Each Other. 1916.**

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
NATIVE LANCASTER COUNTY CORN														
Lancaster	7.5	4.2	1,414	193	276	469	240	87	3.0	7.8	6.4	.51	.28	.289
Thurston	8.4	4.4	1,320	208	171	379	145	85	3.5	6.5	6.0	.48	.29	.237
Lincoln	5.7	2.4	1,061	133	75	208	62	83	5.1	5.4	5.1	.45	.29	.228
Cherry	7.1	2.9	959	165	130	295	94	72	3.2	6.7	5.6	.40	.25	.085
Kimball	6.0	2.2	1,100	119	3	122	2	55	9.0	3.1	2.8			
NATIVE THURSTON COUNTY CORN														
Lancaster	7.4	3.3	1,209	174	197	371	165	84	3.2	7.0	6.1	.47	.31	.280
Thurston	7.8	3.5	985	169	152	321	125	82	3.1	5.8	5.5	.44	.29	.245
Lincoln	5.5	2.1	941	142	64	206	51	80	4.6	4.2	4.9	.41	.27	.225
Cherry	6.8	2.2	891	145	163	308	130	80	2.9	7.2	5.8	.44	.30	.175
Kimball	5.5	3.1	563	100	22	122	15	70	4.6	6.3	4.4	.28	.22	.081
NATIVE LINCOLN COUNTY CORN														
Lancaster	6.1	3.1	849	167	197	364	160	81	2.2	7.4	5.8	.45	.35	.316
Thurston	7.6	3.2	939	151	119	270	100	84	3.5	5.2	5.3	.43	.33	.307
Lincoln	5.1	1.7	792	118	119	237	92	77	3.3	5.7	5.1	.43	.31	.266
Cherry	6.4	2.1	840	143	146	289	112	77	2.9	7.6	5.8	.42	.32	.215
Kimball	5.1	1.6	491	76	55	131	40	73	3.7	5.3	4.9	.34	.28	.124
NATIVE CHERRY COUNTY CORN														
Lancaster	6.0	2.8	833	155	166	321	131	79	2.6	6.4	5.9	.43	.33	.327
Thurston	7.1	3.0	936	119	135	254	115	85	3.7	5.5	5.1	.43	.33	.295
Lincoln	4.7	1.4	762	108	76	184	62	81	4.1	5.2	4.6	.41	.33	.264
Cherry	5.8	1.7	624	121	151	272	121	80	2.2	7.3	5.5	.41	.32	.209
Kimball	4.9	1.4	536	73	79	152	62	78	3.5	5.4	5.2	.36	.29	.148
NATIVE KIMBALL COUNTY CORN														
Lancaster	5.4	1.7	594	108	123	231	96	78	2.6	6.2	5.8	.43	.34	.307
Thurston	6.4	2.3	647	111	125	236	101	81	2.7	5.4	5.6	.42	.36	.326
Lincoln	4.2	1.2	472	73	62	135	50	80	3.4	5.0	5.0	.40	.35	.308
Cherry	4.7	1.0	376	70	109	179	88	81	2.0	6.2	5.8	.41	.31	.216
Kimball	4.2	1.1	425	67	91	158	73	80	2.7	5.5	5.4	.39	.30	.197

*Compiled from Tables 17 to 21.

TABLE 23.—*Summary of Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Interchanged with Each Other. For Each Native Type the Native Home-Grown Crop is Regarded as 100 Per Cent. 1916.**

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circum-ference	Length	Width	Weight
County (1)	*Percent* (2)	*Percent* (3)	*Per cent* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	*Per cent* (8)	*Per cent* (9)	*Per cent* (10)	*Per cent* (11)	*Per cent* (12)	*Per cent* (13)	*Per cent* (14)	*Per cent* (15)
NATIVE LANCASTER COUNTY CORN														
Lancaster	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Thurston	112	105	93	108	62	81	60	98	117	83	94	94	104	82
Lincoln	76	57	75	69	27	44	26	95	170	69	80	88	104	79
Cherry	95	69	68	85	47	63	39	83	106	86	87	78	89	29
Kimball	80	52	78	62	1	26	0.8	63	300	40	44	......	......	......
NATIVE THURSTON COUNTY CORN														
Thurston	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	95	94	123	103	130	115	132	102	103	121	111	107	107	114
Lincoln	70	60	95	84	42	64	41	98	149	72	89	93	93	92
Cherry	87	63	90	86	107	96	104	98	94	124	105	100	103	71
Kimball	70	89	57	60	14	38	12	85	149	109	80	64	76	33
NATIVE LINCOLN COUNTY CORN														
Lincoln	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	120	182	107	141	165	154	174	105	66	130	114	105	113	119
Thurston	149	188	119	128	100	114	109	109	106	91	104	100	106	115
Cherry	125	123	106	121	123	122	122	100	88	133	114	98	103	81
Kimball	100	94	62	64	44	55	43	95	112	93	96	79	90	47
NATIVE CHERRY COUNTY CORN														
Cherry	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	103	165	133	128	110	118	108	99	111	88	107	105	103	156
Thurston	122	176	150	98	89	93	95	106	168	75	93	105	103	141
Lincoln	81	82	122	89	50	68	51	101	186	71	84	100	103	126
Kimball	84	82	86	60	52	56	51	97	159	74	94	88	91	71
NATIVE KIMBALL COUNTY CORN														
Kimball	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	129	154	140	161	135	146	131	97	96	113	107	110	113	156
Thurston	152	209	152	166	137	149	138	101	100	98	104	108	120	165
Lincoln	100	109	111	109	68	85	68	100	126	91	93	103	117	156
Cherry	112	91	88	104	120	113	120	101	74	113	107	105	103	110

*Compiled from data in Table 22

TABLE 24.—*Summary of Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Different Regions. 1916.*

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Feet* (2)	*Feet* (3)	*Sq. In.* (4)	*Grams* (5)	*Grams* (6)	*Grams* (7)	*Grams* (8)	*Per cent* (9)	*Sq. In.* (10)	*Inches* (11)	*Inches* (12)	*Inches* (13)	*Inches* (14)	*Grams* (15)
EASTERN NEBRASKA TYPES														
Lancaster	7.7	3.9	1,357	204	250	454	212	85	3.0	7.6	6.3	.49	.29	.294
Thurston	8.5	4.3	1,347	199	154	353	129	83	3.8	6.4	5.6	.46	.29	.241
Lincoln	5.7	2.4	1,046	137	70	207	57	82	5.1	4.9	5.1	.44	.28	.236
Cherry	7.0	2.7	1,000	165	140	305	107	76	3.2	7.2	5.7	.42	.27	.134
Kimball	6.3	2.7	979	129	20	150	14	63	6.6	5.5	4.1	.26	.24	.076
CENTRAL NEBRASKA TYPES														
Lancaster	6.4	3.1	1,040	177	184	361	148	80	2.7	6.9	6.0	.45	.33	.344
Thurston	7.3	3.2	1,010	142	136	278	116	85	3.6	5.5	5.4	.45	.32	.290
Lincoln	4.9	1.6	828	110	87	197	70	80	4.4	5.5	5.1	.43	.32	.299
Cherry	6.2	2.0	809	143	135	278	104	76	2.8	7.1	5.6	.42	.32	.203
Kimball	5.4	1.7	626	90	63	153	47	74	3.9	5.4	5.1	.34	.28	.122
WESTERN NEBRASKA TYPES														
Lancaster	5.5	1.8	684	134	140	274	112	80	2.5	6.4	5.7	.44	.34	.300
Thurston	6.3	2.3	724	102	127	228	104	82	3.2	5.6	5.6	.42	.34	.274
Lincoln	4.2	1.2	520	84	58	147	46	79	3.6	4.5	4.9	.40	.34	.290
Cherry	5.1	1.1	468	80	127	208	103	81	3.3	5.9	5.6	.38	.35	.239
Kimball	4.5	1.2	394	70	73	143	55	75	2.8	4.7	4.8	.36	.28	.172

TABLE 25.—*Summary of Plant Characteristics of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Different Regions. Data Are Based on Corn Grown in Lancaster County as 100 Per Cent.*

Where grown	Plant measurements			Dry matter				Shelling per cent	Leaf area per gram dry matter	Ear measurements		Kernel measurements		
	Height of stalk	Height of ear	Leaf area	Stover	Ear	Total	Grain			Length	Circumference	Length	Width	Weight
County (1)	*Per cent* (2)	*Per cent* (3)	*Per cent* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	*Per cent* (8)	*Per cent* (9)	*Per cent* (10)	*Per cent* (11)	*Per cent* (12)	*Per cent* (13)	*Per cent* (14)	*Per cent* (15)
EASTERN NEBRASKA TYPES														
Lancaster	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Thurston	110	110	99	98	62	78	61	98	127	84	89	94	100	82
Lincoln	74	61	77	67	28	46	27	96	170	64	81	90	97	81
Cherry	91	69	74	81	56	67	50	89	107	95	90	86	93	46
Kimball	82	69	72	63	8	33	7	74	220	72	65	53	83	26
CENTRAL NEBRASKA TYPES														
Lancaster	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Thurston	114	103	97	80	74	77	78	106	133	80	90	100	97	84
Lincoln	77	52	80	62	47	55	47	100	163	80	85	96	97	87
Cherry	97	64	78	81	73	77	70	95	104	103	93	93	97	59
Kimball	84	55	60	51	34	42	32	92	144	78	85	76	85	35
WESTERN NEBRASKA TYPES														
Lancaster	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Thurston	114	128	106	76	91	83	93	102	128	87	98	95	100	91
Lincoln	76	67	76	63	41	54	41	99	144	70	86	91	100	97
Cherry	93	61	68	60	91	76	92	101	132	92	98	86	103	80
Kimball	82	67	58	52	52	52	49	94	112	73	84	82	82	57

grain weight, 100 and 30; shelling percentage, 100 and 92; amount of leaf area per unit dry matter, 100 and 90; ear length, 100 and 70; and ear circumference, 100 and 84.

When native Lancaster County corn was grown in Lancaster, Thurston, Cherry, Lincoln, and Kimball Counties, the respective relative total plant weights were: 100, 81, 63, 44, and 26, while the respective relative grain weights were: 100, 60, 39, 26, and 0.8.

When native Kimball County corn was planted in Kimball, Lincoln, Cherry, Thurston, and Lancaster Counties, the relative total plant weights were respectively: 100, 85, 113, 149, and 146. Corresponding relative grain values were: 100, 68, 120, 138, and 131.

In less extreme cases than the above comparisons, less marked growth differences usually exist, and great regularity and consistency did not always prevail. In the main, however, indications are similar.

In Table 24 the twelve native corn types which were planted in five different parts of the State are assembled regionally. Thus, we have three groups—eastern, central, and western Nebraska types, grown comparatively in Lancaster, Thurston, Cherry, Lincoln, and Kimball Counties. In Table 25 relative values are given for each group, based on the mean results for the corn grown in Lancaster County.

The relative total yields of dry matter for eastern Nebraska types grown in Lancaster, Thurston, Cherry, Lincoln and Kimball Counties were respectively: 100, 78, 67, 46, and 33. Corresponding relative yields of grain per plant were: 100, 61, 50, 27 and 7.

The relative total yields of dry matter for central Nebraska types grown in Lancaster, Thurston, Cherry, Lincoln, and Kimball Counties were respectively: 100, 77, 77, 55, and 42. Corresponding yields of grain were: 100, 78, 70, 47, and 32.

The relative total yields of dry matter for western Nebraska types grown in Lancaster, Thurston, Cherry, Lincoln, and Kimball Counties were respectively: 100, 83, 76, 54, and 52. Corresponding grain yields were: 100, 93, 92, 41, and 49.

The effects of interchanging native corn types upon their relative development may be similarly observed for other plant characters by a study of the tables.

HISTOLOGICAL LEAF CHARACTERS

The eleven native types considered morphologically in the preceding discussion, were also compared as to leaf structure when grown in both Lancaster and Kimball Counties. These

represent extreme conditions, and it is believed that by such comparison, structural differences due either to hereditary adaptation or to mere environmental adjustment, may be determined. (Tables 26-28.) The methods of sampling and technique were the same as previously described. Seven hundred and twenty transectional leaf measurements, and one thousand epidermal counts and measurements were made for each of the eleven corn types grown in Lancaster and Kimball Counties, respectively.

Comparing eastern, central, and western Nebraska types when grown in Lancaster County we have the following relative leaf values: (1) Leaf thickness, 100, 103, and 104; (2) average epidermal thickness, 100, 100, and 103; (3) thickness of cuticle, 100, 101, and 98; (4) number of vascular bundles per unit of cross section, 100, 95, and 100; (5) number of stomata per unit area of epidermis, 100, 101, 97; (6) length of stoma, 100, 100, and 100; (7) length of stomatal aperture, 100, 94, and 90; (8) length of epidermal cell, 100, 93, and 94; and (9) width of epidermal cell, 100, 100, and 104.

Corresponding relative values for corn grown in Kimball County were: (1) Leaf thickness, 100, 89, and 95; (2) average epidermal thickness, 100, 97, and 96; (3) thickness of cuticle, 100, 98, and 98; (4) number of vascular bundles per unit of cross section, 100, 103, and 101; (5) number of stomata per unit area of epidermis, 100, 104, and 102; (6) length of stomata, 100, 101, and 98; (7) length of stomatal aperture, 100, 101, and 96; (8) length of epidermal cell, 100, 100, and 100; and (9) width of epidermal cell, 100, 95, and 100.

As an average for corn grown in both Lancaster and Kimball Counties the respective relative values for eastern, central, and western Nebraska types were: (1) Leaf thickness, 100, 96, and 100; (2) average epidermal thickness, 100, 99, and 100; (3) thickness of cuticle, 100, 100, 98; (4) number of vascular bundles per unit cross section of leaf, 100, 99, and 100; (5) number of stomata per unit area of epidermis, 100, 102, and 99; (6) length of stomata, 100, 100, and 99; (7) length of stomatal aperture, 100, 97, and 93; (8) length of epidermal cell, 100, 97, and 97; and (9) width of epidermal cell, 100, 97, and 102.

To determine the effect of the environment only upon the corn leaf structure, we may compare the mean results of the twelve types grown in Lancaster County as against the same corn grown in Kimball County. The relative values based on Lancaster County as 100 per cent are: (1) Leaf thickness, 100 and 87; (2) average epidermal thickness, 100 and 91; (3) thickness of cuticle, 100 and 97; (4) number of vascular bundles

TABLE 26.—*Histological Leaf Measurements of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Southeastern Nebraska. (Lancaster County) 1916.*

Source of seed	Thickness of			Per cent of total leaf thickness of			Thickness of cuticle of			Per cent of epidermal thickness of			Number vascular bundles per cm. leaf width
	Leaf	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis	Total epi-dermis	Upper epi-dermis	Lower epi-dermis	Total cuticle	Upper cuticle	Lower cuticle	Total cuticle	
County (1)	*Microns* (2)	*Microns* (3)	*Microns* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	*Microns* (8)	*Microns* (9)	*Microns* (10)	*Per cent* (11)	*Per cent* (12)	*Per cent* (13)	(14)
EASTERN NEBRASKA TYPES													
Richardson	220.0	33.8	27.0	15.3	12.2	27.5	5.8	4.9	10.7	17.1	18.1	17.6	69.2
Lancaster	221.8	35.1	29.2	15.8	13.1	28.9	6.5	5.9	12.4	18.5	20.2	19.3	68.6
Washington	209.8	33.4	25.9	15.9	12.3	28.2	6.4	5.6	12.0	19.1	21.6	20.3	70.1
Thurston	225.2	36.3	29.0	16.1	12.8	28.9	6.6	6.2	12.8	18.1	21.3	19.7	66.5
Nuckolls	219.2	34.3	28.6	15.6	13.0	28.5	6.8	6.3	13.1	19.8	22.0	20.9	66.7
Average	219.2	34.6	27.9	15.7	12.7	28.4	6.4	5.8	12.2	18.5	20.6	19.6	68.2
CENTRAL NEBRASKA TYPES													
Kearney	228.9	35.3	29.5	15.4	12.9	28.2	6.4	5.9	12.3	18.1	20.0	19.0	64.4
Holt	224.5	32.9	27.1	14.6	12.0	26.6	6.6	6.2	12.8	20.0	22.8	21.4	68.7
Lincoln	228.2	35.1	28.4	15.4	12.4	27.7	6.2	5.6	11.8	17.6	19.7	18.6	60.5
Cherry	222.1	34.6	28.1	15.5	12.6	28.1	6.5	6.1	12.6	18.7	21.7	20.2	66.8
Average	225.9	34.5	28.3	15.2	12.4	27.6	6.4	5.9	12.3	18.6	21.1	19.8	65.1
WESTERN NEBRASKA TYPES													
Kimball	224.0	34.2	27.6	15.2	12.3	27.5	5.9	5.1	11.0	17.2	18.4	17.8	68.6
Grant	232.5	36.9	30.4	15.9	13.0	28.8	6.9	6.1	13.0	18.7	20.0	19.3	68.1
Average	228.2	35.5	29.0	15.5	12.6	28.1	6.4	5.6	12.0	17.9	19.2	18.5	68.3

TABLE 26 (continued).—*Histological Leaf Measurements of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Southeastern Nebraska. (Lancaster County) 1916.*

Source of seed	Number of stomata per sq. m. m.			Length of stoma			Length of stomatal aperture			Length of epidermal cell		Width of epidermal cell	
	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis
County (1)	(2)	(3)	(4)	*Microns* (5)	*Microns* (6)	*Microns* (7)	*Microns* (8)	*Microns* (9)	*Microns* (10)	*Microns* (11)	*Microns* (12)	*Microns* (13)	*Microns* (14)
EASTERN NEBRASKA TYPES													
Richardson	76.9	90.5	83.7	48.3	48.1	48.2	16.7	16.4	16.5	87.2	86.4	33.1	33.9
Lancaster	80.2	102.7	91.4	49.5	48.5	49.0	17.0	16.6	16.8	83.2	83.5	34.5	34.0
Washington	81.5	95.9	88.7	50.5	47.0	48.7	17.7	17.6	17.6	88.5	91.9	34.1	34.5
Thurston	79.1	93.0	86.0	50.9	50.2	50.5	16.9	16.8	16.8	81.7	81.6	32.7	34.2
Nuckolls	75.6	91.1	83.3	51.6	51.9	51.7	17.8	18.0	17.9	81.8	79.2	34.6	33.7
Average	78.7	94.6	86.6	50.2	49.1	49.6	17.2	17.1	17.1	84.5	84.5	33.8	34.1
CENTRAL NEBRASKA TYPES													
Kearney	68.2	82.2	75.2	51.3	49.3	50.3	17.9	17.1	17.5	82.5	80.4	35.0	34.2
Holt	91.0	115.9	103.4	47.6	46.7	47.1	15.6	15.5	15.5	77.5	77.2	31.4	31.9
Lincoln	79.8	81.6	80.7	50.7	53.3	52.0	14.3	16.1	15.7	77.9	79.0	34.5	36.7
Cherry	78.6	103.5	91.0	51.1	47.7	49.4	15.3	15.4	15.3	77.7	77.8	34.2	33.1
Average	79.4	95.8	87.6	50.2	49.2	49.7	16.0	16.0	16.0	78.9	78.6	33.8	34.0
WESTERN NEBRASKA TYPES													
Kimball	79.3	94.8	87.0	48.8	49.4	49.1	15.2	15.7	15.4	78.6	83.6	34.4	34.8
Grant	72.6	91.3	81.9	51.5	49.2	50.3	15.1	15.5	15.3	78.2	77.9	36.2	35.8
Average	75.9	93.0	84.4	50.1	49.3	49.7	15.1	15.6	15.3	78.4	80.7	35.3	35.3

TABLE 27.—*Histological Leaf Measurements of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Extreme Western Nebraska. (Kimball County) 1916.*

Source of seed	Thickness of			Per cent of total leaf thickness of			Thickness of cuticle of			Per cent of epidermal thickness of			Number vascular bundles per cm. leaf width
	Leaf	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis	Total epi-dermis	Upper epi-dermis	Lower epi-dermis	Total cuticle	Upper cuticle	Lower cuticle	Total cuticle	
County (1)	*Microns* (2)	*Microns* (3)	*Microns* (4)	*Per cent* (5)	*Per cent* (6)	*Per cent* (7)	*Microns* (8)	*Microns* (9)	*Microns* (10)	*Per cent* (11)	*Per cent* (12)	*Per cent* (13)	(14)
EASTERN NEBRASKA TYPES													
Richardson	202.6	30.5	25.3	15.0	12.4	27.4	6.3	5.9	12.2	20.6	23.3	21.9	78.3
Lancaster	222.0	33.6	27.2	15.1	12.2	27.3	6.6	6.2	12.8	19.6	22.8	21.2	79.7
Washington	204.1	30.9	25.9	15.1	12.7	27.7	5.8	5.5	11.3	18.7	21.2	19.9	67.9
Thurston	197.5	31.8	26.7	16.1	13.5	29.6	5.6	5.6	11.2	17.6	20.9	19.2	78.9
Nuckolls	195.3	32.1	28.5	16.4	14.6	31.0	6.3	6.0	12.3	19.6	21.0	20.3	77.3
Average	204.3	31.8	26.7	15.5	13.1	28.6	6.1	5.8	12.0	19.2	21.8	20.5	76.4
CENTRAL NEBRASKA TYPES													
Kearney	176.2	31.2	26.0	17.7	14.7	32.4	6.5	6.1	12.6	20.8	23.4	22.1	79.4
Holt	198.2	32.0	26.2	16.1	13.2	29.3	6.3	6.0	12.3	19.7	22.9	21.3	74.8
Lincoln	182.6	30.1	26.6	16.4	14.5	30.9	6.0	5.8	11.8	19.9	21.8	20.8	77.6
Cherry	172.3	29.2	25.0	16.9	14.5	31.4	5.4	5.0	10.4	18.4	20.0	19.2	82.7
Average	182.3	30.6	25.9	16.8	14.2	31.0	6.0	5.7	11.8	19.7	22.0	20.8	78.6
WESTERN NEBRASKA TYPES													
Kimball	204.7	32.0	26.3	15.6	12.8	28.4	6.3	5.8	12.1	19.7	22.0	20.8	71.3
Grant	184.5	28.5	25.2	15.4	13.6	29.0	5.9	5.6	11.5	20.7	22.2	21.4	82.6
Average	194.6	30.2	25.7	15.5	13.2	28.7	6.1	5.7	11.8	20.2	22.1	21.0	76.9

TABLE 27 (continued).—*Historological Measurements of Corn Types When Moved from Their Various Native Nebraska Localities and Grown in Extreme Western Nebraska. (Kimball County) 1916.*

Source of seed	Number of stomata per sq. m. m.			Length of stoma			Length of stomatal aperture			Length of epidermal cell		Width of epidermal cell	
	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis
County (1)	(15)	(16)	(17)	*Microns* (18)	*Microns* (19)	*Microns* (20)	*Microns* (21)	*Microns* (22)	*Microns* (23)	*Microns* (24)	*Microns* (25)	*Microns* (26)	*Microns* (27)
EASTERN NEBRASKA TYPES													
Richardson	84.5	93.7	89.1	43.4	45.8	44.6	10.8	13.7	12.2	75.3	79.0	32.0	32.8
Lancaster	85.4	109.4	97.4	48.2	47.4	47.8	15.3	15.2	15.2	80.7	78.1	32.5	32.1
Washington	74.2	94.9	84.5	47.3	47.1	47.2	14.4	14.8	14.6	83.2	80.0	31.8	34.6
Thurston	81.3	107.3	94.3	47.8	45.2	46.5	14.6	13.9	14.2	81.0	78.4	31.7	30.8
Nuckolls	74.8	89.9	82.3	50.8	49.0	49.9	16.5	15.6	16.0	80.7	79.0	32.1	32.1
Average	80.0	99.0	89.5	47.5	46.9	47.2	14.3	14.6	14.4	80.2	78.9	32.0	32.5
CENTRAL NEBRASKA TYPES													
Kearney	83.0	84.2	83.6	48.2	49.9	49.0	14.7	16.0	15.3	79.0	81.1	29.9	30.8
Holt	68.5	108.8	88.6	50.3	49.5	49.9	16.0	16.0	16.0	81.1	82.0	33.0	29.1
Lincoln	79.8	109.4	94.6	48.6	46.4	47.5	14.3	14.3	14.3	80.3	80.7	31.7	29.9
Cherry	94.5	115.1	104.8	43.7	43.3	43.5	12.8	12.7	12.7	76.9	77.5	30.4	29.0
Average	81.4	104.4	92.9	47.7	47.3	47.5	14.4	14.7	14.6	79.3	80.3	31.2	29.7
WESTERN NEBRASKA TYPES													
Kimball	89.1	106.1	97.6	44.8	43.6	44.2	12.6	12.6	12.6	78.0	76.5	32.4	31.6
Grant	71.9	98.9	85.4	49.2	47.2	48.2	15.6	14.8	15.2	83.8	79.8	34.4	31.1
Average	80.5	102.5	91.5	47.0	45.4	46.2	14.1	13.7	13.9	80.9	78.1	33.4	31.3

TABLE 28.—*Summary of Histological Leaf Measurements of Corn Types When Moved from Their Various Native Nebraska Localities and Grown Both in Extreme Eastern and Western Nebraska. 1916.**

Source of seed	Thickness of			Per cent of total leaf thickness of			Thickness of cuticle of			Per cent of epidermal thickness of			Number vascular bundles per cm. leaf width
	Leaf	Upper epidermis	Lower epidermis	Upper epidermis	Lower epidermis	Total epidermis	Upper epidermis	Lower epidermis	Total cuticle	Upper cuticle	Lower cuticle	Total cuticle	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
ACTUAL VALUES													
Corn Grown in Lancaster County (Eastern Nebraska)													
	Microns	*Microns*	*Microns*	*Per cent*	*Per cent*	*Per cent*	*Microns*	*Microns*	*Microns*	*Per cent*	*Per cent*	*Per cent*	
Eastern Nebraska	219.2	34.6	27.9	15.7	12.7	28.4	6.4	5.8	12.2	18.5	20.6	19.6	68.2
Central Nebraska	225.9	34.5	28.3	15.2	12.4	27.6	6.4	5.9	12.3	18.6	21.4	20.1	65.1
Western Nebraska	228.2	35.5	29.0	15.5	12.6	28.1	6.4	5.6	12.0	17.9	19.2	18.5	68.3
Average	224.4	34.9	28.4	15.5	12.6	28.0	6.4	5.8	12.2	18.3	20.4	19.4	67.2
Corn Grown in Kimball County (Western Nebraska)													
Eastern Nebraska	204.3	31.8	26.7	15.5	13.1	28.6	6.1	5.8	12.0	19.2	21.8	20.5	76.4
Central Nebraska	182.3	30.6	25.9	16.8	14.2	31.0	6.0	5.7	11.8	19.7	22.0	20.8	78.6
Western Nebraska	194.6	30.2	25.7	15.5	13.2	28.7	6.1	5.7	11.8	20.2	22.0	21.0	76.9
Average	193.7	30.9	26.1	15.9	13.5	29.4	6.1	5.7	11.9	19.7	21.9	20.8	77.3
RELATIVE VALUES													
Corn Grown in Lancaster County (Eastern Nebraska)													
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Eastern Nebraska	100	100	100	100	100	100	100	100	100	100	100	100	100
Central Nebraska	103	100	101	97	98	97	100	102	101	100	104	102	95
Western Nebraska	104	103	104	99	99	99	100	97	98	97	93	94	100
Corn Grown in Kimball County (Western Nebraska)													
Eastern Nebraska	100	100	100	100	100	100	100	100	100	100	100	100	100
Central Nebraska	89	96	97	108	108	108	98	98	98	103	101	101	103
Western Nebraska	95	95	96	100	101	100	100	98	98	105	101	102	101

*Data compiled from Tables 26 and 27.

TABLE 28 (continued).—*Summary of Histological Leaf Measurements of Corn Types When Moved from Their Various Native Nebraska Localities and Grown Both in Extreme Eastern and Western Nebraska. 1916.**

Source of seed	Number of stomata per sq. m. m.			Length of stoma			Length of stomatal aperture			Length of epidermal cell		Width of epidermal cell	
	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Average	Upper epi-dermis	Lower epi-dermis	Upper epi-dermis	Lower epi-dermis
(1)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
ACTUAL VALUES													
Corn Grown in Lancaster County (Eastern Nebraska)													
				Microns	*Microns*	*Microns*	*Microns*	*Microns*	*Microns*	*Microns*	*Microns*	*Microns*	*Microns*
Eastern Nebraska	78.7	94.6	86.6	50.2	49.1	49.6	17.2	17.1	17.1	84.5	84.5	33.8	34.1
Central Nebraska	79.4	95.8	87.6	50.2	49.2	49.7	16.0	16.0	16.0	78.9	78.6	33.8	34.0
Western Nebraska	75.9	93.0	84.4	50.1	49.3	49.7	15.1	15.6	15.3	78.4	80.7	35.3	35.3
Average	78.0	94.5	85.9	50.2	49.2	49.7	16.1	16.2	16.1	80.6	81.3	34.3	34.5
Corn Grown in Kimball County (Western Nebraska)													
Eastern Nebraska	80.0	99.0	89.5	47.5	46.9	47.2	14.3	14.6	14.4	80.2	78.9	32.0	32.5
Central Nebraska	81.4	104.4	92.9	47.7	47.3	47.5	14.4	14.7	14.6	79.3	80.3	31.2	29.7
Western Nebraska	80.5	102.5	91.5	47.0	45.4	46.2	14.1	13.7	13.9	80.9	78.1	33.4	31.3
Average	80.6	102.0	91.3	47.4	46.5	47.3	14.3	14.3	14.3	80.1	79.1	32.2	31.2
RELATIVE VALUES													
Corn Grown in Lancaster County (Eastern Nebraska)													
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Eastern Nebraska	100	100	100	100	100	100	100	100	100	100	100	100	100
Central Nebraska	101	101	101	100	100	100	93	94	94	93	93	100	100
Western Nebraska	96	98	97	100	100	100	88	91	90	93	95	104	103
Corn Grown in Kimball County (Western Nebraska)													
Eastern Nebraska	100	100	100	100	100	100	100	100	100	100	100	100	100
Central Nebraska	102	105	104	100	101	101	101	101	101	99	102	97	91
Western Nebraska	101	103	102	99	97	98	99	94	96	101	99	104	96

*Data compiled from Tables 26 and 27.

per unit of cross section, 100 and 115; (5) number of stomata per unit area of epidermis, 100 and 106; (6) length of stomata, 100 and 95; (7) length of stomatal aperture, 100 and 88; (8) length of epidermal cell, 100 and 98; and (9) width of epidermal cell, 100 and 93.

The immediate result of growing corn under more adverse climatic conditions, namely, shortage of heat units and moisture, is to reduce the vegetative development in all its phases. Stalks become shorter, and bear the ear closer to the ground; leaf development and the production of plant substances are markedly reduced. The general effect is to reduce the opportunity for transpiration and photosynthesis. Associated with this reduction in vegetative growth is found a reduction in the size of the vegetative unit—the cell. Accordingly, under the more adverse conditions the leaves are thinner, as are also the epidermis and the cuticle. The stomata are more numerous in a given area of leaf surface. The stomata as well as the stomatal apertures are somewhat reduced in size. Furthermore, the cells being smaller, more vascular bundles occur in a unit of cross-section.

The fallacy of viewing such changes as being teleological or purposive is seen in the existence of both favorable and unfavorable reactions to adverse climatic conditions, moisture shortage being one of these conditions. A reduction in the plant size and leaf area and stomatal aperture indicates favorable reactions for reduced water requirements. On the other hand, a thinner epidermis and cuticle and a relative increase in number of stomata and water carrying vascular bundles suggest greater water dissipating capacity, and, therefore, must be considered as an adverse development inconsistent with the idea of purposiveness. Probably the true explanation of these reactions is that the reduced turgor and reduced rapidity of cell division caused by limited moisture and heat results in a materially smaller physical development.

When a comparison is made of native adapted corn types grown in their respective home localities, a combination of two entirely distinct factors is involved in the relative plant development, namely heredity and environment. Differences due to hereditary adaptation cannot be definitely determined by such comparisons, since the effect of the difference in environment is not eliminated.

Such comparisons of native home-grown corn types disclose that corn from the more adverse conditions, moisture shortage being one of the conditions, is smaller in practically all of its vegetative growth characters. The stalk and ear height, leaf area and plant substance are markedly lower. The

stomata are somewhat shorter while the leaf and epidermal thickness are practically identical. Stomata are more numerous and in general the cell size is somewhat smaller.

Probably the actual hereditary differences existing between types adapted to favorable and to unfavorable climatic conditions may be best determined by growing them all comparatively in the same environment under favorable conditions. In general when grown in eastern Nebraska, (Lancaster County), western Nebraska corn was markedly smaller in size of plant, leaf area, and plant substance than was eastern Nebraska corn. On the other hand, the leaf thickness, epidermal and cuticular thickness, relative number of vascular bundles, number of stomata per unit leaf area, and size of stomata were rather similar for corn of both sources. The data suggested that a slightly smaller stomatal aperture associated with a somewhat smaller epidermal cell is characteristic of the short season dry land types of western Nebraska. This would not seem to be of any adaptive importance because the reduction is insufficient to act as a check upon transpiration, as may be seen in Table 30.

COMPARATIVE YIELDS OF NATIVE TYPES

During 1916 and 1917, the native corn types from various parts of the state were compared for yield at the Experiment Station. Yields were based on the center row of duplicate three-row fifteenth-acre plats in which only hills with a full number of plants, three per hill, and surrounded by a full stand, were harvested. The results are given in Table 29. The average yields for eastern, central and western Nebraska types for the two years were respectively: 59.8, 46.2, and 31.6 bushels per acre. The corresponding maturity dates were September 24, September 21, and September 12.

No attempt has been made in connection with these investigations to make a reliable comparative yield per acre test for the various native corn types. Such a test would involve the growing of each type at several different planting rates for a period of years in order to determine the optimum rate for each, and to average seasonal effects.† In any environment as a general rule the maximum yield is obtained for the smaller and earlier types at a thicker planting rate than for the larger, later maturing types. Tests of this sort have almost universally been made at a single arbitrary planting rate which is likely to be too thin for the smaller types when compared under favorable growing conditions, and too thick for the larger types when compared

†Kiesselbach, T. A., 1918, Nebraska Agricultural Experiment Station Research Bulletin No. 13, pp. 45-47.

TABLE 29.—*Yields of Corn Types When Moved from Their Various Native Nebraska Localities and Grown Three* Plants Per Hill at the Experiment Station (Lancaster County) 1916-1917.*

Source of seed	Date tasseling			Date ripe			Yield grain per acre		
	1916	1917	Average	1916	1917	Average	1916	1917	Average
County							*Bushels*	*Bushels*	*Bushels*
EASTERN NEBRASKA TYPES									
Richardson	7–31	8–8	8–4	9–21	10–1	9–26	64.0	63.0	63.5
Lancaster	7–27	8–5	8–1	9–20	10–1	9–25	66.9	65.0	65.9
Washington	7–30	8–7	8–3	9–18	10–4	9–26	68.0	66.7	67.8
Thurston	7–25	8–1	7–28	9–14	9–20	9–17	47.3	47.3	47.3
Nuckolls	7–29	8–5	8–1	9–22	9–28	9–25	55.0	55.2	55.1
Average	....	....	8–1	....	....	9–24	....	....	59.8
CENTRAL NEBRASKA TYPES									
Kearney	7–20	7–31	7–25	9–16	10–1	9–23	52.1	59.2	55.6
Holt	7–24	7–31	7–27	9–15	9–28	9–21	47.6	44.5	46.0
Lincoln	7–15	7–28	7–21	9–12	9–26	9–19	40.5	42.7	41.6
Cherry	7–16	7–30	7–23	9–12	9–26	9–19	45.7	37.5	41.6
Average	....	....	7–24	....	....	9–21	....	....	46.2
WESTERN NEBRASKA TYPES									
Kimball	7–13	7–25	7–19	9–8	9–12	9–10	27.3	26.7	27.0
Grant	7–15	8–1	7–23	9–12	9–18	9–15	39.1	33.6	36.3
Average	....	....	7–21	....	....	9–12	....	....	31.6

*These yields probably do not do full justice to the central and western Nebraska types since experience has indicated that the optimum rate of planning for the smaller types is greater than for the larger eastern types.

TABLE 30.—*Transpiration Relationship of Native Corn from Relatively Dry and Humid Regions. Four Years Average, 1914-1917.*

Source of seed and variety	Native county	Height of plant	Total dry matter	Leaf area per plant	Total water transpired	Transpiration per gram dry matter	Transpiration per square inch leaf area
(1)	(2)	*Inches* (3)	*Grams* (4)	*Sq. in.* (5)	*Kilo.* (6)	*Grams* (7)	*Grams* (8)
		WESTERN NEBRASKA					
Marten's White Dent	Kimball	72	286	675	68.479	240	101
Calico	Lincoln	88	441	995	103.078	233	103
Average		80	363	835	85.778	236	102
		EASTERN NEBRASKA					
Hogue's Yellow Dent	Lancaster	109	513	1,270	123.947	240	98
*University No. 3	Wayne	94	426	1,049	105.359	250	105
Average		101	469	1,159	114.653	245	101
		NEW YORK STATE					
Rocky Mountain Dent		93	384	891	92.861	235	105
Wood's White Dent		96	442	1,107	101.576	232	94
Average		94	413	999	97.218	233	100

The data in columns 7 and 8 are averages of ratios for the four years and not ratios of averages.

*University No. 3 originated six years prior to these experiments from native Wayne County (northeast Nebraska) corn, and is smaller and about one week earlier maturing than typical Lancaster County corn.

under adverse conditions. In eastern Nebraska, the average optimum planting rate for small varieties is likely to be about 65 per cent thicker than for large varieties.

COMPARATIVE TRANSPIRATION OF EASTERN AND WESTERN CORN TYPES

The preceding morphological and histological adaptation studies have indicated that the chief adaptive characteristic of dry-land short-season corn was a marked reduction in vegetative growth. There was no definite indication of favorable structural adaptive reaction, tho a somewhat shorter stomatal aperture prevailed. This was regarded more as a dwarfish correlation, than as a directly adaptive feature. If adaptively effective, the shorter aperture should be expected to reduce the relative amount of transpiration per unit leaf area. This is not the case, as shown in Table 30.

Two native varieties each from western Nebraska, eastern Nebraska, and New York state were grown to normal maturity during four years, at the Nebraska Experiment Station, in large potometers, and the relative use of water determined. The native climates of western Nebraska, eastern Nebraska, and New York increase progressively in precipitation, and atmospheric humidity. Accordingly, this investigation affords an opportunity to study the adaptation occurring in corn as a reaction to moisture shortage. The method for determining the transpiration is the same as that described in Nebraska Research Bulletin No. 6, 1916, pp. 45, 48 and 49.

The transpiration per square inch leaf area was practically the same for corn native to all three regions. For western Nebraska, eastern Nebraska, and New York types it was respectively: 102, 101, and 100 grams water transpired per square inch leaf area. These cannot be regarded as adaptive differences. On the other hand the total amounts of water transpired per plant were respectively: 85.778, 114.653, and 97.218 kilograms. Eastern Nebraska and New York corn transpired respectively: 34 and 13 per cent more per plant than western Nebraska corn. Comparing the two most extreme native Nebraska types tested, namely Kimball County and Lancaster County corn, we find that the latter used 81 per cent more water per plant, 3 per cent less per unit leaf area, and equal amounts per unit dry matter produced. The Lancaster County corn plants were 51 per cent taller, had 88 per cent greater leaf area and 79 per cent greater dry matter than the Kimball County corn.

COMPARATIVE YIELDS OF CORN FROM VARIOUS SOURCES IN EASTERN NEBRASKA

The following test was made to throw light on two questions: (1) What variation in yield may be expected in corn grown by different farmers in the same community? and (2) How do local varieties compare in yield with varieties secured at some distance?

The tests were made at the Nebraska Experiment Station in Lancaster County. Yields were based upon the middle rows of well-replicated three-row plats of which the first fifty consecutive full-stand hills were harvested and air dried. Thus variation in stand, variety plat competition, and soil differences were rather largely eliminated. All being fairly large varieties, it would appear that a uniform rate of planting should give significant results.

Hogue's Yellow Dent corn has been grown at the Experiment Station for about twenty years and has long been regarded as unsurpassed in yield under Experiment Station conditions. The Nebraska White Prize corn grown at the Station has been regarded as one of the most productive white varieties and has been grown there for twelve years. The other local corn secured from ten near-by farmers has in most cases been grown by them ten or more years, and has been handled in the customary farm manner. Likewise the corn types secured from other eastern counties had been grown there for a long term of years and were regarded as fully adapted. The results are given in Table 31.

As an average for the three years, the home grown Hogue's Yellow Dent outyielded seed from all other sources. Of the local varieties the lowest yielder was 7.7 bushels less than Hogue's Yellow Dent. Three of the ten local corns yielded within 3 per cent as much as Hogue's, which yielded 6 per cent more than the average of all other local sorts.

Of the seed obtained at a distance from other eastern counties, one yielded 16.7 bushels less than Hogue's. Another yielded 10.5 bushels less. Three of the remaining five yielded within two bushels of the home-grown Hogue's Yellow Dent.

The data suggest that there may be considerable variation in yielding capacity of corn grown by different farmers in the same locality and also among corn secured from various distant sources. Seed from three southeastern counties with more favorable growing conditions averaged 56.9 bushels as against 66.7 bushels for home grown Hogue's Yellow Dent. Seed from four northeastern counties with somewhat shorter growing season but equal in rainfall, averaged 63.7 bushels. Thus the relative yields

TABLE 31.—*Comparative Yield Test at the Nebraska Experiment Station of Corn Secured Locally, and from Distant Eastern Nebraska Localities. Three Year Average, 1915-1917.*

Native seed from: Grower	Native seed from: County	Variety or color	Total number of plats averaged	Rate per hill	Date tasseling	Date ripe	Shrinkage	Yield per acre
							Per cent	
SEED FROM WITHIN FIVE MILES OF EXPERIMENT STATION								
Nebraska Experiment Station	Lancaster	Hogue's Yellow Dent	131	3	8–6	9–27	15.4	66.7
R. B. Roberts	Lancaster	Yellow	21	3	8–8	9–26	14.6	62.6
S. Moore	Lancaster	Moore's White Dent	21	3	8–7	9–26	13.2	65.3
C. Stanley	Lancaster	St. Charles White	21	3	8–5	9–26	14.8	63.1
J. T. Graham	Lancaster	Reid's Yellow Dent	21	3	8–7	9–26	17.0	61.8
J. T. Graham	Lancaster	Boone County White	21	3	8–9	9–26	18.0	59.4
L. K. Schoenleber	Lancaster	White	21	3	8–6	9–27	16.5	60.9
E. Aronson	Lancaster	Chase's White Dent	21	3	8–6	9–26	14.2	63.6
J. F. Jensen	Lancaster	Chase's White Dent	21	3	8–7	9–27	16.2	64.6
C. W. Clarke	Lancaster	St. Charles White	21	3	8–5	9–26	12.1	65.9
Emery Darby	Lancaster	Yellow	21	3	8–7	9–27	15.3	59.0
Nebraska Experiment Station	Lancaster	Nebraska White Prize	21	3	8–7	9–27	14.3	63.4
SEED FROM OTHER EASTERN NEBRASKA COUNTIES								
C. J. Brush	Nemaha	Boone County White	17	3	8–11	10–3	22.0	50.0
F. J. Rist	Richardson	Reid's Yellow Dent	17	3	8–9	9–28	19.5	64.6
William Ernst	Johnson	Nebraska White Prize	17	3	8–7	9–28	20.1	56.2
Lee Smith	Washington	Nebraska White Prize	17	3	8–8	9–27	14.7	60.4
Anderson Brothers	Wayne	Reid's Yellow Dent	17	3	8–5	9–24	8.4	63.5
F. H. Roggenbach	Cuming	Reid's Yellow Dent	17	3	8–6	9–27	12.4	65.8
R. R. Seymour	Dodge	Reid's Yellow Dent	17	3	8–8	9–27	13.2	65.0

All yields based on fifty normal hills in the center row of 3-row plats.

TABLE 32.—*Comparative Yields of Local Corn Versus Corn Imported from Other States. Two Year Average, 1916 and 1917.*

Source of seed	Variety	Total number of plats averaged	Rate per hill	Date tasseling	Date ripe	Shrinkage	Yield per acre
						Per cent	*Bushels*
LOCAL NEBRASKA EXPERIMENT STATION VARIETIES							
Lincoln, Nebr	Hogue's Yellow Dent	4	3	8–4	9–25	10.3	64.0
Lincoln, Nebr	Nebraska White Prize	4	3	8–7	9–27	11.3	66.1
Average		4	3				65.0
IMPORTED VARIETIES							
Wooster, Ohio	Clarage	4	3	8–1	9–23	7.4	42.6
Columbia, Mo	Reid's Yellow Dent	4	3	8–6	9–28	13.6	60.2
Urbana, Ill	Reid's Yellow Dent	4	3	8–5	9–27	9.7	61.7
Ames, Iowa	Reid's Yellow Dent	4	3	8–7	9–27	7.8	65.6
Lafayette, Ind	Reid's Yellow Dent	4	3	8–8	9–28	8.4	65.3
Manhattan, Kas	Commercial White	4	3	8–9	10–2	21.9	55.4
Manhattan, Kas	Pride of Saline	4	3	8–6	9–30	19.4	60.2
St. Paul, Minn	Minnesota No. 13	4	3	7–30	9–17	6.0	40.3
Brookings, S. D	Disco Ninety Day	4	3	7–29	9–13	6.5	44.2
Average		4	3				55.0

of: (1) Well-acclimated home-grown Station seed, (2) seed from three northeastern counties, and (3) seed from three southeastern counties were respectively: 100, 96, and 85.

The performance of the three Nebraska White Prize corn samples secured from different sources and compared at the Nebraska Station is of special interest. Seed which had been grown upward of thirteen years by the Experiment Station in Lancaster County and by William Ernst of Johnson County originated from seed grown by Lee Smith in Washington County. The grain yields of corn from the three sources were respectively: 63.4, 56.2, and 60.4 bushels per acre. Thoro local acclimatization improved it for Experiment Station conditions, whereas, seed having been acclimated farther southeast was thereby reduced in productivity for the conditions prevailing at the Experiment Station.

LOCAL CORN COMPARED WITH CORN FROM OTHER STATES

During 1916 and 1917 seed corn was obtained from eight neighboring states and compared at the Experiment Station with the two acclimated local varieties—Hogue's Yellow Dent and Nebraska White Prize. The imported varieties were obtained from the Experiment Stations of the respective states and were acclimated to the conditions prevailing at those Experiment Stations. One variety was grown from each state except Kansas, from which two varieties were tested. Methods of testing were the same as in the preceding tests. The results are given in Table 32.

In this test the two local varieties, Hogue's Yellow Dent and Nebraska White Prize, yielded respectively 64.0 and 66.1 bushels per acre with an average of 65 bushels. Of the nine imported corns, two yielded practically the same as the local, three yielded within four bushels, one nine and a half bushels less, and three more than twenty bushels less. The nine imported corns averaged ten bushels less than the local.

One may conclude from the data that, as a general principle, locally adapted seed is superior to seed haphazardly imported. However, the mere matter of distance is not an absolute deciding factor in adaptation. It is quite possible to secure highly productive seed from a distance, but such introductions may meet with disaster unless preceded by local experience with the corn. Without such preceding definite experience, the rational procedure is to plant only locally grown corn known to be adapted. Importation is likely to be successful in proportion to the similarity of growing conditions of the source and destination of the seed.

(3M)